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Laboratory for a New Architecture

The Airport Terminal, Eero Saarinen and the Historiography of Modern Architecture

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ACADEMIC DISSERTATION

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Abstract

In this historiographical study I evaluate the placement of Eero Saarinen's airport terminals in the history of modern architecture. His Trans World Airlines Terminal (1956-62) and Dulles International Airport (1958-63) were the first airport terminals to enter the annals of modern architecture. I hypothesize that the airport terminal was previously excluded as a building type from historiography since it was seen as infrastructure, not architecture. Furthermore, its modernity did not coincide with the aims of historians, who could not utilize an emergent building type to demonstrate how modernism revolutionized architectural vocabularies. Discussing the related histories of aviation and technologies, the typological instability of the airport terminal, and Saarinen's architectural practice, I utilize genealogy, microhistory, and Science and Technology Studies to intervene in the historiography of modern architecture. Specifically, I question the assumption that architecture follows technological developments, the narrow interpretation of modernity dominating the writing of architectural history, and the resulting myopia in the classification of emerging building types.

I view Saarinen's architectural practice as one of the many laboratories for a new architecture. Mapping such laboratories reveals a multifaceted view of postwar architecture, where modernism is explained by individual actors laboring at their localized sites to mediate a particular kind of modernity. I argue that Saarinen's engagement with technology and his laboratory-like working methods reconciled the contradictions between modern architecture and its blind spot, the airport terminal. This synthesis allowed the terminal building to transcend its utilitarian-technological nature as transportation infrastructure and led to its inclusion in the history of modern architecture as a building type that has its own history and parameters for design.

This study makes three contributions. It outlines the history of the airport terminal emphasizing buildings that could have easily found their place in the canon of modern architecture. It explains the reasons for their exclusion and suggests ways to reduce the canon's myopia towards variants of modernism. More broadly, this study contributes to our understanding of the historiography of modern architecture and its logic of including emergent buildings by acknowledging the airport terminal as an emblematic building type of the twentieth century.

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Toronto, Canada on April 5, 2015 Susanna Santala

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1. Introduction

> "We in the office spend so much time traveling, that we know only too well the physical comforts required by today's travelers. Using materials and structural systems appropriate to this century of flight, we have tried to make a building which is functional, comfortable and dramatic." [1]
>
> *Eero Saarinen*

Although Saarinen wrote these lines about the TWA Terminal, the sentiment applies to all three airports he designed: Trans World Airlines Terminal (1956-62), Dulles International Airport (1958-62) and Athens International Airport (1958-69). Planned in collaboration with the engineering firm led by Othmar H. Ammann and Charles S. Whitney, they combined functional solutions with aesthetic expression appropriate to the dawning jet age. Within a relatively short period, Saarinen advanced airport design significantly. TWA, which served as a corporate unit terminal, was Saarinen's first airport commission. He approached the design problem scientifically, studied the functionality of existing airports, and experimented with modern technologies and form. From his design laboratory emerged a functionally innovative and aesthetically expressive building. As the first airport specifically built to serve jet aircraft, Dulles International Airport presented a design problem that was unique at the time. The innovative mobile lounge concept, which Saarinen developed for this sublimely modern terminal building, revolutionized the typology and the aesthetics of the airport. In the less known Athens International Airport terminal Saarinen interpreted International Style modernism to express local modernity in the context of classical Greek architecture. Hence, Saarinen combined research with aesthetic experimentation to construct buildings that stand as statements about a particular kind of modernity. More precisely, they mediate modernity.

These three terminals have for decades excited the imagination of travelers. Now they stand in the beginning of this study and evoke a specific question: why were Saarinen's terminals included in the canon of influential modern buildings when airport terminal as a building type had been otherwise excluded from the historiography of modern architecture, i.e. the corpus of histories addressing the question of modernism in architecture?

In this historiographical study I evaluate the placement of Eero Saarinen's airport terminals in the history of modern architecture. I hypothesize that the airport terminal was previously excluded as a building type from historiography since it was seen as infrastructure, not architecture. Furthermore, its modernity did not coincide with the aims of historians, who could not utilize an emergent building type to demonstrate how modernism revolutionized architectural vocabularies. Therefore, Saarinen's Trans World Airlines Terminal and Dulles International Airport, which were the first airport terminals

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[1] *Saarinen Captures Spirit of Flight in TWA Structure 1957. News from TWA press release, Nov. 13, 1957, 1. Press materials, box 330, folder 932. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

to enter the annals of modern architecture, and Athens International Airport, which did not enter the canon, destabilize historiography. Discussing the related histories of aviation and technologies, the typological instability of the airport terminal, and Saarinen's architectural practice, I utilize genealogy, microhistory, and Science and Technology Studies to intervene in the historiography of modern architecture. Specifically, I question the assumption that architecture follows technological developments, the narrow interpretation of modernity dominating the writing of architectural history, and the resulting myopia in the classification of emerging building types.

I view Saarinen's architectural practice as one of the many laboratories for a new architecture. Mapping such laboratories reveals a multifaceted view of postwar architecture, where modernism is no longer the universal panorama explaining architectural phenomena, but is rather explained by individual actors laboring at their localized sites to mediate a particular kind of modernity. I argue that these practices made the airport terminal transcend its utilitarian-technological nature as transportation infrastructure and led to its inclusion in the history of modern architecture as a building type materializing the transitory and nomadic modernity of air travel.

The historical context of this study is the postwar era and its architecture culture, which Joan Ockman has vaguely and somewhat arbitrarily defined as the years extending from 1943, when the outcome of the Second World War was evident, to 1968, the year of political protests, countercultural movements, and the emergence of postmodernism.[2] As Ockman acknowledges, periodization of this sort is never unproblematic. However, what she proposes is a period long enough to cover most of the decisive events and seminal texts of postwar modernism. Events and phenomena then suggest their own timeframe, which in the case of my study on Saarinen's airports are the years between 1909 and 1969. This effectively covers the typological development of the airport terminal until the completion of my last case study, but also coincides with the common definition of modern architecture and postwar architecture culture.

This idea of the event suggesting its own timeframe is best expressed by Marc Bloch, who in *The Historian's Craft* claims that centuries and decades, used for the classification of time, are entirely arbitrary. Instead, phenomena should determine their proper periods, as the most precise measurement is the one best adapted to the nature of the events.[3] Aiming for a synthesis between different structural levels of time, Ferdinand Braudel has identified them as the slowly changing geographical time of man in relation to his environment (long-term history or *longue durée);* the gradually changing time of civilizations, states, societies, and economic cycles measured in centuries and decades; and the fast moving history of men and events. In the case of architecture it is evident that all these layers of time are present since architecture is a cultural activity realized in the realm of politics and economics. It involves the event of the completion of a building (*histoire évenementielle*), reflects and affects the gradually changing time of ideas (*histoire de mentalité*), and as a built environment has a special relationship to the slowly changing time of geographies and climates (*longue durée*). While this study only

[2] *Ockman 1993, 13-24.*

[3] *Bloch 1953, 181-184.*

addresses the history of events and ideas, the *longue durée* is present especially in the case of the airport terminal that is also physically linked to different geographies and cultures in the networks of airways.[4]

In the immediate aftermath of the war modern architecture was profoundly altered amidst the turbulence of reconstruction, the Cold War, strong economic growth and related phenomena such as the emergence of consumer culture, the adaptation of progressive war technologies into civil use, and the expansion of urban networks and mass communication. Aware of the potential but also the destructive power of large technological systems and modern science, architects explored new technologies and architectural vocabularies to spatially organize modern living and mediate the experience of modernity. The legacy of the avant-garde of the 1920s and 1930s was reinterpreted into increasingly heterogeneous and controversial forms of unorthodox modernisms. Hence, the still prevailing International Style was contradicted by several countercurrents variously defined as New Humanism, New Regionalism, New Brutalism, New Formalism, New Historicism and mannerist or late modernism. On one hand, this pluralism of modernisms was a consequence of modern architecture encountering new geographies and local traditions, on the other it resulted from a search for a wider vocabulary of modern architecture. While the modern masters Ludwig Mies van der Rohe, le Corbusier, and Walter Gropius were still practicing, a younger second generation of modernists was searching for new forms better expressing what in their opinion was a radically different period. Hence, architecture of the 1950s is in this study defined as postwar modernisms in the plural and viewed as a period leading from interwar functionalism to the late 1960s paradigm shift to postmodernism.

These different types of postwar modernisms are in this study mapped through a detailed discussion on the genealogy of modern architecture. Following Michel Foucault's definition of genealogy,[5] I establish a discursive framework through an analysis of the annals of modern architecture and focus especially on postwar historians and their seminal work, including Reyner Banham's *Theory and Design in the First Machine Age* (1960), Sigfried Giedions's *Space, Time and Architecture: The Growth of a New Tradition* (1941), Henry-Russell Hitchcock's *Architecture: Nineteenth and Twentieth Centuries* (1958), and Manfredo Tafuri's *The Sphere and the Labyrinth: Avantgardes and Architecture from Piranesi to the 70's* (1980). Through a close reading of these histories and their contemporary critiques,[6] I define modernism as a hybrid concept under constant

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[4] *Braudel and Bloch are both representatives of the Annales School founded by Bloch and Lucien Febvre at the University of Strasbourg in the 1920s. The focal point of the new problem-oriented and interdisciplinary approach to history was the journal* Annales d'histoire économique et sociale*, which was first published in 1929. The school became associated with the idea of the* longue durée*, and later with serial history or* histoire sérielle*. These histories often proceeded from structural history to economic, social and mental conjunctures and ended with an analysis of short-term events and change over time. Braudel 1980a (1949), 3-5; Braudel 1980b (1958), 25-54, especially 26-29; Burke 1990, 12-16, 53-59.*

[5] *Foucault 1998 (1971), 369-391.*

[6] *Banham 1980 (1960); Giedion 1956 (1941); Hitchcock 1987 (1958); Tafuri 1987 (1980); Heynen 1999; Tournikiotis 1999; Vidler 2008.*

redefinition and address modernisms in the plural, acknowledging that while architectural modernisms were most explicitly formulated in these histories, they have since then been repeatedly revaluated.

These modernisms are, in turn, understood as practices mediating modernity, i.e. the experience of individuals subjected to the processes of modernization.[7] As these processes are many, so too it is of importance in this study to localize and identify those forms of modernization that are relevant to aviation and transportation. This is to say that, in the end, modernisms are not universal or placeless, but are dependent on the actors interpreting localized conditions of modernity and defining the specific processes of modernization they are subjected to.

In the case of a building type serving a specific technology, it is necessary to clarify the position of technology in progressive architecture. Following Bruno Latour and Donald MacKenzie, I argue that the assumed evolution trajectory of technology, or modern architecture for that matter, simply does not exist, but is anticipated, enforced, and to some extent made real by politically, economically and socially motivated actors.[8] Therefore, if there is a parallel between architecture and technology, it is not one of architecture being a logical and true expression of the most recent technology, engineering defeat or "the machine age,"[9] but of architecture and technology being similar cultural constructions. This definition of architecture's relationship to technology yields such ideas as "the machine," inherent in the historiography of modern architecture, techno-deterministic. Therefore "the machine" is in this study placed in quotes and defined by its relationship to contemporary technologies.

Given that the airport is both a technological and an aesthetic design problem, the airport is in this study defined as a large technological system. While such a definition would easily reduce the airport into transportation infrastructure without architectural value, I argue that an airport is defined not only by its functionality as infrastructure, but also by the ability of its terminal building to transcend this technological-utilitarian function and become a landmark building similar to its closest predecessor, the central railway station. As was argued in the debate between Reyner Banham and Nikolaus Pevsner involving the status of the bicycle shed,[10] a building, no matter how modest in its appearance, becomes architecture, if it is designed with aesthetic intention and has the ability, in the manner of the bicycle shed or the airport terminal, to define place and organize space. Consequently, the question whether the bicycle shed or the airport terminal should be included in the history of modern architecture, is a question of architectural quality and aesthetics, not typology. Therefore, it is odd that the airport terminal only penetrated the histories of architecture in the sixties and the seventies,

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[7] *Berman 1988 (1982), 15-17.*

[8] *Latour 1988 (1984); Law & Callon 1992; MacKenzie 1990.*

[9] *Banham 1980 (1960).*

[10] *The bicycle shed is an ordinary shed built to shelter bicycles on the backyard or garden of a British townhouse. Pevsner used it as an example on non-architecture compared to the cathedral as architecture. Banham was of a different opinion as an avid cyclist and protagonist of a wider definition of architecture defined by the aesthetic intentions of the builder. Banham 1996 (1990), 292-299.*

despite several aesthetically noteworthy, modern, and functionally progressive precedents. These buildings then form a curious blind spot within the narrative of modern architecture.

After tracing the absence of the airport terminal in the histories, I look more closely at this blind spot and, inspired by Carlo Ginzburg and microhistory,[11] explore the gaps the terminal creates in the historiography as clues for its exclusion, and evidence of a different kind of modernity. My aim is to write people and history into the airport terminal and reveal it as space, where architects negotiate aesthetics in relation to technology, and a place where technology is utilized by thousands, and on the global scale, millions, daily. While the historians overlooked the airport, avant-garde modernists such as le Corbusier and Antonio Sant'Elia were fascinated with the aircraft and envisioned airfields in their utopian urban plans. They celebrated "the machine," defined here as the imagery of such technologies as the automobile, the aircraft, the ocean liner and the locomotive of their time. Some of these plans were included in the histories of modern architecture, but none of the existing airfields or pioneering, often functionalist air terminals. Yet, the airport is a profoundly modern building type, whose typology not only answered the demands set by the aircraft it was designed to serve, but the architectural expression of which reflected contemporary architecture culture. Despite its modernity it was left unnoticed unlike other utilitarian structures such as bridges, parkways, grain elevators and railway stations.[12] It then seems that the airport terminal was technologically too modern, rather than stylistically not modern enough to merit careful consideration.

The story of the early airfields, air terminals and postwar airports is in this study narrated in a manner that avoids constructing an evolutionary trajectory and, instead, appreciates the evident instability of the building type amidst actors shaping its form and function. Keeping in mind that typology is a classificatory device utilized by historians interested in development trajectories of building types, I describe early airports and architecturally noteworthy terminal buildings and map the geographically dispersed impulses. The choice of the airport terminals discussed here is based on their relative importance in the emergence of the building type, their geographical location as international transportation hubs, and their relevance to my case studies. For these reasons, this narrative focuses on the terminals in Europe and the United States, while I acknowledge that interesting terminal buildings were simultaneously erected outside the centers of modern architecture.

The emphasis of the description is on the postwar era when technologically innovative aircraft construction, developed during the World War II, advanced aviation into a common form of transportation. The growing volume of traffic required modern, functionally organized facilities and contemporary designs. Thus, solving the building problem of the modern airport became the task of the postwar generation and attracted many of its most capable and talented architects. Aiming for novelty and innovation, and serving both as infrastructure for aviation and landmark for community, the emergent building type of the terminal oscillated between technological impulses and avant-garde

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[11] *Ginzburg 1980 (1976); Ginzburg 1993.*

[12] *See for instance Giedion 1956 (1941).*

architecture, functionality and monumentality. In this process the airport terminal became a symbol of modernity in the expanding networks of air transportation.

Saarinen's airport terminals were seminal in the history of this building type. While providing rational and pragmatic solutions to the new design problem, they proposed some of the most innovative designs for an airport aesthetically. They were well-functioning airport terminals that reinterpreted International Style and redefined monumentality and expression in the debates over postwar modern architecture. Through these terminals Saarinen negotiated technology and aesthetics. Therefore, Saarinen's terminal buildings did not merely reorganize the airport. They were architectural statements that mediated the specific experience of transient modernity for nomadic travelers.

Based on the documented design process, I view Saarinen's practice as a design laboratory, which carefully collected and organized data, conducted experiments, and then constructed new design practices and reinterpretations of modernism.[13] Furthermore, rather than a solitary innovator, I argue that Saarinen was what John Law calls a "heterogeneous engineer," a mediator, who skillfully manipulated various networks involved in the design process.[14] Through his carefully orchestrated practice, Saarinen convinced clients, fellow architects and the public to accept his designs. Hence, the office not only had teams to produce alternative designs to sell the right one, but a public relations professional to ensure a desired response. While this is not atypical postwar architecture culture, its professionalism and success is striking. Thus Saarinen managed to not only sell his designs and find support for his practice, but to also enforce the image of a user his architecture imagined and furthermore, to convince others to *become* the users his architecture imagined.

The modernism proposed by the Saarinen office is yet another reinterpretation in a line of air-minded modernisms. Since his terminals are included in the later histories of modern architecture, the predecessor terminals, and the typological development of the modern airport terminal should have left traces in the annals. Postwar airport terminals did not emerge from a vacuum. They represent one stage in the development of a building type that had its predecessors and has since taken various new forms. Yet, it is relevant to ask, if canonization is at all a desirable method of history writing. It is only after "an end result" has emerged that a trajectory of airport typology or modern architecture is drawn and certain buildings evaluated representative, pioneering or revolutionary. This trajectory is then an interpretation reflecting contemporary values and changing views on various modernisms.[15]

More than concentrating (or merely adding architectural objects) on the list of influential buildings it is important to look at historical phenomena as events and reflect on the reasons for their relative value and place within the canon. Nevertheless, the practice of architectural history relies on the dating of buildings and the documentation of events, actors and networks in time. And even more importantly, historiography is defined by its exclusions as much as it is defined by what is included in the canon of modern

[13] *Latour 1988 (1984).*

[14] *Law 1987.*

[15] *Nikula 2000; Saarikangas 2002.*

architecture. Therefore, buildings that were previously left unnoticed should be documented and critically viewed as part of architectural history, not only reflecting on the reasons why they were overlooked before, but also on the reasons why they are found interesting today. In the case of the airport terminal, inclusion revises the definition of modernity inherent in the historiography of modern architecture and reexamines architecture's relationship to technology. In the current research environment, disillusioned and critical views of technology make the airport terminal an especially interesting case study. The airport terminal then is a point through which architectural modernisms may be analyzed and the narrative of modern architecture entered before the historiography became a black box of sorts, an entity whose inner workings are concealed and of which we only know the input of architectural phenomena and the output of a canon of influential buildings.[16]

This study contributes to our knowledge about modern architecture, its historiography and logic of inclusion, by suggesting that the invention of modernisms in architecture is contingent. Formulations of modernisms are defined by their historic position and are valid only in their localized and temporal conditions of modernity. The exclusion and later inclusion of the airport terminal in the history of modern architecture was determined by the definitions given to modernity and technology in relation to architecture. It then follows that if the concepts of modernity and technology inherent in the historiography of modern architecture are questioned, and the complex interfaces between architecture, modernity and technology acknowledged instead, the airport terminal appears as an emergent building type with a specific position amidst the processes of modernization. Subsequently, the airport terminal is no longer merely infrastructure, but architecture occupying a well-defined position in the history of modern architecture. It is the very avatar of technological modernity without which the narrative of modern architecture is incomplete.

In order to support this argument, I utilize a variety of material as evidence. Histories of architecture and theories about science and technology explain certain facets of the invention of modern architecture and its relationship to technology, but this picture is incomplete without the archival material documenting a specific case; the practice and architectural thinking of Eero Saarinen, and the design process of his airport terminals. This material, that validates the argument through a close reading of the architecture of a single practitioner, is dispersed in several locations including Eero Saarinen Collection, Manuscripts and Archives, Yale University Library; Cranbrook Archives; Aline and Eero Saarinen Papers, Archives of American Art, Smithsonian Institution; Archives of the Museum of Finnish Architecture, and the Canadian Centre for Architecture. Other evidence includes reviews and debates over Saarinen's architecture in architectural periodicals, recent research on Saarinen, and discussions with Kevin Roche, the Director of Design in the Saarinen office. Furthermore, the specific case of the airport terminal opens up a wealth of material concerning aviation, its history and imagery, and regulations and ideals guiding the design of aviation infrastructure.

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[16] *The black box is defined in MacKenzie 1990, 26; Latour 1987, 2-3.*

This heterogeneous material is in this study explored through genealogy, microhistory, and Science and Technology Studies, acknowledging that historians act as narrators carefully selecting, including, excluding and organizing their material in order to form narratives that are necessarily distorted by the implicit biases of their creator. To me the complexity of these narratives, incomplete as they necessary are, is the reason why the historiography of modern architecture appears as such a fascinating, multifaceted construction. It is the historian's task, I believe, to explore these narratives, and the ruptures and vague openings that are necessarily created in-between them. Fascination with the structures of history is also the reason why the narrative of the airport terminal in this study unfolds only slowly, each layer revealing new stories, and new questions to extend the narrative. Hence, the structure of this study traces the actual sequence of the research process.

Documenting the first reading of the material, this study begins with a description of the three airport terminals Saarinen created,[17] and continues with the introduction of the architect who designed them. Following the initial question –why were these airports included in the canon when their predecessors left to trace in the annals –I embark on a journey introducing new material with each question asked. My first approach to the research question is to investigate the historiography of modern architecture and specifically its silences and ruptures in relation to the emergence of the airport terminal. The second approach is that of describing Saarinen's architectural practice as a laboratory for a new architecture. I begin with the genealogy of modern architecture and the role of technology in modern architecture, then read the histories in relation to the airport, and narrate the story of the airport terminal finally arriving, again, at the architect's office to discuss, how Saarinen negotiated technology and aesthetics as the two parameters for the design of his airport terminals and, how he labored as a "heterogeneous engineer" to mediate their modernity.

1.1. Eero Saarinen's Modern Airport Terminals

> "We wanted architecture to reveal the terminal, not as a static, enclosed place, but a place of movement and transition."[18]
>
> *Eero Saarinen*

[17] *An earlier version of chapter 1.1. was published in* Eero Saarinen: Shaping the Future. *Santala 2006a, 300-307.*

[18] Eero Saarinen on His Work: A Selection of Buildings Dating from 1947 to 1964 with Statements by the Architect *1962, 60.*

1.1.1. Trans World Airlines Terminal, 1956-62

Even today, the sweeping form of Saarinen's Trans World Airlines Terminal at John F. Kennedy International Airport is instantly recognizable from the air train circling around the Airport City. No longer functional, it has remained a relic on the airfield since TWA closed down its operations in 2001 (fig. 1.1). The appearance of this remarkable building is outdated and removed from contemporary aviation. However, once it served as a glorious entrance to New York and the unexplored worlds TWA offered on its air routes. The airline called it the "Winged Gateway to the World of Flight" in its advertisement, where the white, expressive form of the terminal glittered, reminiscent of a bird taking off or having just landed among the similarly sleek and curved aircraft. Even when Saarinen denied this metaphor, it is easy to see how the extended barrel vaults, the beaklike drainpipe and the sculptural supports made the unlikely transformation of a heavy concrete building into a weightless flying creature seem almost possible. This building was intended to capture the imagination of travelers and function as advertisement for the airline; it was suppose to express the "drama and specialness and excitement of flight."[19]

It is intriguing to imagine how travelers, dressed in elegant suits, approached the terminal under the sheltering canopy and entered the buzzing lobby of sweeping forms circling the central staircase and mezzanine, curving into a sculptural flight information desk and waving along the circular walls glad in white terracotta tiles (fig. 1.2). The movement suggested by the outer form was echoed in the interior that embraced the studied, circular movement patterns of the travelers. Having checked-in on the ground level, the travelers ascended to the mezzanine to sip martinis in one of the carmine-colored stylish lounges and observed aircraft on the busy apron. Once flights were called they disappeared into a tubular corridor that led to a transit lounge and fingers extending toward the aircraft. They embarked, and the plane took off to one of TWA's destinations. This was the heyday of aviation and flying was the new form of mass transit.

In this era of postwar prosperity and advances in aerospace expertise, airports were a frequent commission for the second-generation modernists. For instance, Minoru Yamasaki of Hellmuth, Yamasaki and Leinweber designed Lambert St. Louis Airport in 1951-61, Carroll, Grisdale & Van Allen built Philadelphia's new airport (1953), and C. F. Murphy completed Chicago's O'Hare International Airport in 1962. Architects constructing terminals along Saarinen at New York International Airport (1957-71) included I.M. Pei and Skidmore, Owings and Merrill. These designers of the postwar generation, including Saarinen, challenged the tropes of interwar modernism, achieving a new heterogeneity of form. Especially experiments with innovative uses for concrete, combined with advances in engineering, opened new options for form. It is then unsurprising that the curving concrete shells and the exceptionally expressive structure of Saarinen's TWA Terminal became a central recurring example in the discourse on new possibilities in construction.

For TWA, its first airport commission, the Saarinen office approached the design problem rationally, by conducting a number of studies and collecting data on airport

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[19] Eero Saarinen on His Work *1962, 60.*

design and the aviation industry. Roger Johnson, who worked in the office at the time, recalls how: "At the time TWA started, commercial jet aircraft was still a thing of the future. They weren't operational and there wasn't anyone available in the Detroit area that we knew of to review the requirements for these planes of the future. New air terminals were few and far between. Almost nothing had been published on the subject. Eero asked me to do some research on air terminal. I went to a number of libraries and checked out architectural journals. Very slim pickings."[20]

Therefore, in a continuous research effort that served each of the three airport terminals Saarinen designed, employees timed enplaning, deplaning, and baggage claims at existing international airports in at least Philadelphia, San Francisco, Baltimore, Dallas, and Chicago. This material was organized into case study files, analyzed and presented as diagrams and statistics to the client (fig. 1.3).[21] While Saarinen was one of the first architects to approach the airport design problem in a scientific manner, such time-motion diagrams were becoming increasingly common in airport design. In fact, the firm's research followed planning guidelines issued by the International Air Transport Association for evaluating adequacy of service for a given population, economic base, and distance from other communities.[22] Special attention was paid to passenger comfort since time spent traveling to business meetings had made Saarinen extremely aware of the inconvenience of air travel.[23] In addition, architects studied the specifics of airplane plans, and consulted both the National Airport Plan and Civil Aeronautics Administration (CAA)

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[20] *Correspondence, Roger Johnson, April 1995 - April 1999, 1-2. Saarinen/Swanson Reunion Records, 2001-14, Box 1, folder 22. Cranbrook Archives. These notes and articles are found in Airport case studies, analysis and research, box 460, folder 1288. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[21] *In the Eero Saarinen Collection airport research (including original notes and studies conducted at the airports, information received from other planners, analysis and presentation panels) has been archived under Dulles International Airport. However, judged on the dates of the material, press releases and recollections of architects, the earlier research in folder 1288 was conducted for the TWA Terminal. Airport case studies, analysis and research, boxes 460-462, folders 1288-1301. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[22] *Planning manuals are included in Research files, box 498, folders 1388-1390. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[23] *Kevin Roche remembers that Saarinen always got on the plane at the last minute, not wanting to waste any time. Being "accustomed to flying he thought the flight experience should be pleasanter." Kevin Roche, interview with the author, New Haven, Conn., July 7, 2006. Saarinen travelled extensively and often wrote letters to his wife Aline onboard airplanes. Correspondence: Eero Saarinen to Aline Saarinen, 1953, box 2, folder 26, 7, 17; folder 27, 19; Correspondence: Eero Saarinen to Aline Saarinen, 1954, box 2, folder 36, 10. Aline and Eero Saarinen Papers, 1906-1977. Archives of American Art, Smithsonian Institution.*

guidelines.[24] This data, once collected and analyzed, served as basis for Saarinen's three airport projects and many of the firm's new and innovative technological solutions.

As airports, and airplanes, were still in a state of rapid development, Saarinen privileged flexibility and expansion in his planning. During the five previous decades of aviation, airports had developed from hangars to multiplex structures of terminal buildings connected to gates by long fingers –the concourses housing concessions and waiting areas. Within these structures, space had to be provided for ticketing, baggage, airline administration, and passenger comfort. As traffic volumes grew there was a growing interest in new spatial arrangements to increase efficiency. Therefore, TWA's operations at New York International Airport, which was popularly known as Idlewild at the time and only later renamed John F. Kennedy International Airport, were to be located in a single-airline terminal within a unit (or decentralized) airport structure, while at Dulles and Athens one terminal was to serve several airlines (centralized airport type).

The advantages of a unit terminal, like TWA, were fast check-in and shorter walking distances from the entrance to the gates, each situated in a spoke radiating from a central waiting lounge. Although such terminals functioned well when used by one airline, they had limited expansion possibilities within the airport. Other disadvantages included having to change terminals when changing airlines, and distanced communication with airport management. However, the single-airline terminals did not need to offer space to management entities like the Port Authority. In contrast, the centralized airport eased transferring airlines and facilitated airport management and communication, but as the airport expanded so too did walking distances. This resulted in structures, where passengers had to proceed through a maze of corridors and lounges to reach the gate from the entrance.[25]

TWA's striking structure derives from its singular purpose to serve one airline, and from Saarinen's careful research into creating efficient pathways from curb to plane (fig. 1.4). The four intersecting concrete vaults, separated by narrow skylights, shelter a main lobby with an information desk, a ticket counter, and a large flight information board. Several bars, restaurants and lounge areas named after TWA destinations were situated on a mezzanine overlooking the lobby. Passengers moved from their cars under a canopy and proceeded directly into the lobby, where departures and arrivals were separated into different functional areas. The interior design paid special attention to the flow of baggage handling and the naturally circular movement pattern of passengers. Whenever possible, Saarinen was interested in mechanizing the movement of people and goods. Moving sidewalks were planned for the concourse tube, but never realized. However, baggage carousels were automated. Ultimately Saarinen planned everything from the building to its ashtrays, creating a uniform environment with shells, wings, and curves at a multitude of

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[24] *Aircraft images and brochures are found in Research files, box 499, folder 1391. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[25] Airport Terminal Buildings *1953, 11-18; Jet Airports: Passenger Terminal Building Design Principles 1960, 168-170; Twentieth Century Building Type: Airport Terminal Buildings 1953, 87-88.*

interrelated scales.[26] As such, this micro-world of travelers can be read as Saarinen's adaptation of the concept of the total work of art to the activities of the jet age. It became a corporate mark for the airline, proposing TWA as the vehicle to unexplored worlds, and dominated the company's subsequent advertising. The complicated structure arrived at through work on models, deepened Saarinen's devotion to this method of design development, while its form attracted attention, increased Saarinen's fame, and provoked criticism from an array of modernists.[27]

1.1.2. Dulles International Airport, 1958-63

The volume of air travel multiplied after World War II as military innovations, and specifically the jet engine, revolutionized flight.[28] At the same time Cold War fears of nuclear attacks on cities accelerated the movement of populations to the American suburbs. New problems of the jet age such as noise nuisance, jet blast and the increased danger of airplane crashes over city centers, stressed the importance of placing airports outside urban structures.[29] Even in the 1950s, Washington National Airport, located only three and a half miles from the Capitol, suffered from numerous problems related to its location in the city. National's shortcomings forced the successor agency of CAA, the Federal Aviation Agency (FAA), to plan and construct Dulles International Airport. After the FAA conducted several studies on time and distance factors, a location about twenty-five miles west of the city, in Chantilly, Virginia, was selected. This exurban location

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[26] *New TWA Terminal to Feature Unique Saarinen Design. News from TWA press release, November 13, 1957; Trans World Flight Center's Four Restaurant Facilities Reflect International Theme, News from TWA press release, May 10, 1961, 1. Press materials, box 330, folder 932. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[27] *Balthazar Korab photographed the TWA model under different lighting conditions, using mirrors to study the effects of the curved inner space. Balthazar Korab, interview with the author, Detroit, Mich., November 11, 2004; Photographs, box 330, folder 923. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library. Interviews with Raymond Bean, Cesar Pelli, and James Smith illuminate this working method. Correspondence, Raymond Bean, May 1999, 1. Saarinen/Swanson Reunion Records, 2001-14, box 1, folder 5. Cranbrook Archives; Correspondence, Cesar Pelli, April 1995-October 2001. Saarinen/Swanson Reunion Records, 2001-14, box 1, folder 33. Cranbrook Archives; Cranbrook reunion transcript 1995, 1-3. Saarinen/Swanson Reunion Records, 2001-14, box 3. Cranbrook Archives; James Smith speaks with John Gerard, April 8, 1982, 5-8. Collection of Oral History Interviews, No. 242. Cranbrook Archives.*

[28] *Bilstein 1984, 167-245;* Federal Aviation Agency's First Annual Report to the President and the Congress *1959.*

[29] The Airport and its Neighbors: The Report of the President's Airport Commission *1952; Galison 2003, 197-225; Pietrasanta 1957, 11-18, 88.*

allowed better area planning to lessen nuisance to neighboring areas, but ultimately created connection problems between the airport and the city.[30]

Building on its research for TWA, the Saarinen office extensively studied the future needs of the jet-dominated airport.[31] At TWA the firm had been solving the needs of a single airline, but at Dulles the design team had to create a multicarrier terminal as well as lay out runways, maintenance facilities, and a control tower. Contemporary articles and design manuals suggested that airport design should be based on the number of operations –daily takeoffs and landings –anticipated for the present and future. This determined the size of apron, number of gates and position of runways in relation to the terminal building and other facilities. Peak-hour traffic dictated the size of the terminal (and specifics, from the number of ticket counters to seats per square foot).[32] Studies on winds and weather helped the design team determine the best location for the airfield, and led to the design of two parallel north-south runways and two supplementary southeast-northwest runways (only one was built).[33] The manuals strongly suggested designing for expansion to accommodate new aircraft with faster speeds and larger turning radii. Hence, the Saarinen office collected information about new airplanes and used technical drawings of aircraft in architectural planning. At Dulles, taxiways run parallel to the main runways and several turnouts were provided for different-size aircraft with varying performance characteristics. However, while the design of Dulles followed design-manual guidelines, it could not anticipate the rapid development of jet aircraft using shorter runways.[34]

The air control tower was placed at the location from which the airfield could best be monitored. Other facilities –airmail and cargo buildings –were also placed on the airfield. These one-story buildings were rectangular and clad in enameled aluminum, and their plainness reflected their hierarchical relation to the terminal. They formed a maintenance area separate from zones for the circulation of passengers and traffic, making operations more efficient and legible. Both physically and verbally, the airport had to communicate with air carriers and ground transportation, with the airfield and the local community.[35]

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[30] Dulles International Airport Master Plan Report 1964.

[31] *Kevin Roche, interview with the author, New Haven, Conn., July 7, 2006.*

[32] Airport Buildings and Aprons: A Reference Document of Principles and Guidance Material for Use by Those Concerned with the Planning of Airport Buildings and Aprons 195*6, 37-47; Jet Airports 1960, 167-182; Twentieth Century Building Type 1953, 69-136.*

[33] *Runway patterns dictated the location of airport terminals. Variously oriented runways provided for safe landings without crosswinds in different conditions. However, in the fifties faster landing speeds, tricycle and crosswind landing gear, and higher wind loads lessened the crosswind effect and allowed airports to have one main runway with a supplementary one oriented in a second direction. Twentieth Century Building Type 1953, 78-80.*

[34] *Research files, boxes 497-499, folders 1378-1391. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[35] Apron Requirements for Turbine-Powered Aircraft: A Reference Document of Principles and Guidance Material for Use by Those Concerned with the Planning of Airport Buildings and Aprons *1958, 1-57*; Dulles International Airport Master Plan Report 1964; *Twentieth-Century Building Type 1953, 80-81.*

Saarinen saw Dulles as a threefold design problem: it was to express the optimism of the jet age, to be a gateway to the nation, and to relate to the federal architecture of Washington, D.C. It was of importance that the airport represented the United States as the leading democratic, economic, political, and military power during the Cold War. Saarinen's choice of materials was intended to relate his modern architecture to the neoclassicism of the National Mall. His use of limestone-aggregate concrete with different polishes, the modernized columns on the terminal façade, the monumental scale, and the minimal structural form all relate the airport to the city's federal classicism. But rather than simply support a lintel, the columns of Dulles lean outward, counteracting the pull of cables and penetrating the suspended roof. The structure is active, inclining upward to the sky. Furthermore, glass panels, which curve between the columns, suggest openness rare in federal buildings (fig. 1.5).[36]

Viewed from the distance, the terminal structure hovers over the rural landscape, resembling a distant gateway. Saarinen paid particular attention to the access road to the airport. As with many of his suburban corporate campus projects, he and landscape architect Dan Kiley choreographed the views of the building and the visitor experience at multiple scales: a straight road leads to a generous ellipse, whose curve mimics that of a pedestrian access ramp. The terminal is located on an ellipse. In designing the building's entrance, Saarinen faced two problems: the difficulty of articulating the entry to a modern, repetitive structure (a problem that recurs in Saarinen's work), and that of providing graceful access to a building where the approach began via automobile and was completed on foot.[37] The problem was partly solved by the use of the ellipse, and the clarity of the terminal plan at the point of entry: passengers arriving in their automobiles enjoyed the magnificent views of the terminal; on reaching the terminal front, they walked through the entrance and arrived directly at the ticketing kiosk. Something of the sublimity of entering a grand, federal-style building or even an ancient Roman temple was maintained.

The Dulles terminal had two floors: one for departing passengers, ticketing and concessions, the other for arriving passengers, baggage claim, and ground transportation. Saarinen's real innovation at Dulles was the employment of new transport vehicles called mobile lounges, which were a kind of giant luxury buses carrying as many as ninety people from the terminal to the plane. Departing passengers proceeded from the ramp through ticketing to the runway side, which was fitted with gates for boarding the mobile lounge that would take them to the plane. Situating concessions and ticketing in the central space allowed free passenger circulation on the enplaning floor and the mobile lounges could also function as waiting areas. Arriving passengers were transported to the terminal by the mobile lounges, whereupon they descended to the ground floor to claim their luggage and proceeded to surface transportation on a separate deplaning ramp, or walked along another ramp to the parking area. The basement served baggage circulation. A south

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[36] Dulles International Airport Master Plan Report *1964*.

[37] *Kevin Roche, one of the office members who worked on the project, encapsulated the latter challenge: unfortunately "you could not drive into the building." Kevin Roche, interview with the author, New Haven, Conn., March 31, 2005.*

finger connecting the terminal to the air control tower had space for clubs and exhibitions (fig 1.6 and 1.7). Communication systems of the airport were also highly developed.[38]

The mobile lounges were a revolutionary approach to airport movement, and designing Dulles around them allowed Saarinen to do away with the usual multitude of finger gates found at most terminals (fig 1.8). This pioneering connection between the terminal and the aircraft was inspired by the introduction of bus systems in several European airports, like London Gatwick and Schiphol Amsterdam.[39] But buses required that passengers use stairs and transfer to the plane on the airfield, whereas the mobile lounge allowed same-level loading at both the terminal and the aircraft, which avoided exposing passengers to the weather and airfield hazards. The mobile lounge could be loaded from both ends, and its height was adjustable to match that of the terminal as well as different airplanes. It was operated by a driver and had simple, buslike mechanics.

For the airport's management, the mobile lounge allowed operational flexibility by separating aircraft operations from passenger facilities. Passengers could be concentrated in one terminal. The mobile lounge could serve different-size aircraft from one gate. Because all airplanes were loaded with mobile lounges, the location of the aircraft did not matter much. Most were parked in two rows of aprons close to the runways so that taxiing (and the related cost of fuel) was minimized. The aircraft could be serviced in the same location as boarding, making it possible to load passengers on one side while mechanics attended to the plane on the other. Saarinen thought the concept was so promising that he hired his friends Charles and Ray Eames to create a film, *The Expanding Airport*, to sell the office's rationale for the lounges to the airlines.[40] Although the federal government accepted the Saarinen office's argument, airlines were reluctant to adopt this system. The initial cost of mobile lounges, which were developed by the Chrysler Corporation, was simply a burden to the airlines, which did not benefit from the reduction in construction costs resulting from the elimination of fingers. However, for the passengers, the experience of cruising through the airfield in the eloquent mobile lounge was futuristic. The ride provided them with varying views of the monumental terminal. And people still marveled at the novel jet aircraft, which encapsulated the excitement of flight.

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[38] Dulles International Airport Master Plan Report *1964*.

[39] *As Kevin Roche remembers: "Saarinen had traveled through an airport with a bus system in Europe, but thought the bus should be a lounge." Kevin Roche, interview with the author, New Haven, Conn., July 7, 2006.*

[40] *The Mobile Lounge Fact Sheet, FAA News press release, undated, 4. Press information, box 497, folder 1367. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Twentieth-Century Building Type 1953, 74; Jet Airports 1960, 170-171, 179-180.*

1.1.3. Athens International Airport, 1958-69

Athens International Airport was the third airport Eero Saarinen designed in collaboration with Ammann & Whitney.[41] While Ammann & Whitney provided the city of Athens with a master plan, Athens Airport was really an extension of an existing national and military airfield. The Hellenikon site had operated as an airport since 1938. Taken over by the Germans during the war and redeveloped by the Greek government since, the airfield had several hangar structures and runways. In the 1950s the airport accommodated both civil and military operations, and the United States was allowed to use the airport for military purposes. However, in anticipation of postwar mass tourism, the Greek government wanted to modernize the airport and build a new terminal to serve international airlines. It was of importance that the terminal would portray Greek modernity and display Greece as a modern nation.

Athens Airport proposed a solution for a modern airport in the context of European classical architecture. Like Dulles, it served as the international gateway to a nation's capital. However, the warm climate and building site on the shore of the Mediterranean, where a rocky landscape descended directly from the terminal location, were quite distinct from the Dulles site and thus posed a different design problem from the start. Saarinen proposed a cantilevered structure that contrasted with the landscape but expressed continuity with the classical tradition. Use of Pentelic-marble-aggregate concrete, along with marble floors and desks, further linked the terminal project to local building materials. The broad, symmetrical layout took a sedate and less skeletal approach to structure than at Dulles. The Greek authorities rejected Saarinen's initial design, and it underwent several changes as it evolved toward a more open and modern form.[42]

The access road from the city followed a curve, allowing varied views as one approached the airport, as at Dulles. Yet Athens officials were concerned not with gridlock but with delays caused by the pedestrians and animal carts that crowded the rural roads. The terminal building was composed of two rectangular forms, with a long box with a heavy cornice cantilevered above a modern peristyle hall (fig. 1.9). The four-sided concrete columns supporting the cantilever flowered out in a form reminiscent of a propeller. The main terminal, located in the lower volume, handled ticketing, passport controls, customs and baggage claims in functionally separated areas. Monumental stairs led passengers from the ground level to the transit hall, separating them from spectators who could observe the runway from an observation deck or the restaurant in the cantilevered volume.

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[41] *Kevin Roche confirms that, importantly, collaboration with Ammann & Whitney was one of the reasons why Saarinen got involved in airport planning. Kevin Roche, interview with the author, New Haven, Conn., July 7, 2006.*

[42] *The changes in design can be followed in the correspondence between local authorities and Saarinen and Ammann & Whitney offices. Correspondence and memoranda, box 568, folders 1576-1577. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

In the first scheme for Athens, a bus system carried passengers to "islands" between the runways, discrete waiting areas served by concessions, and surrounded by several gates. In the final scheme, open-air fingers replaced the bus system, a low-tech solution achievable in a mild climate, with landscaped terraces edged by low walls, pools and flowers. Deplaning passengers entered the terminal at its corners from the open walkways, passed through passport control and customs, claimed their luggage, and left the terminal for ground transportation. In the 1950s airports had developed into inconvenient, mazelike structures that functioned poorly, but Saarinen approached the design problem rationally, aiming to make the airport a machine for mass transit. Hence, Athens Airport served essentially as an interface between the automobile and the aircraft (fig. 1.10).[43]

Airport terminals designed by Saarinen embodied what Reyner Banham called the "Second Machine Age;" an era when smaller machines became available to households and aviation revolutionized the concepts of distance and speed.[44] At a time when the public still marveled at the beauty of aircraft and was fascinated by flight, flying became affordable for a growing number of people. Travelers were ready to conquer the world on transatlantic flights, and it became commonplace to fly to business meetings across the continent (as Saarinen had been doing for years).

All three of Saarinen's airport terminals sought answers for the specific needs of the client and the location, and they offered those clients designs that were appropriate for the century of flight. Each had an innovative structural form following Saarinen's six principles of modern architecture: functional integrity, structural clarity, appropriateness to the time, expression of the building, concern with total environment, and carrying a concept to its ultimate conclusion.[45] All proposed innovative solutions, functioned as monumental symbols, and gave form to the jet age. But airports are constantly undergoing change. Developments in aviation have imposed new requirements on existing structures and although Saarinen anticipated these needs, his plans to accommodate future operations have been followed only sparingly. Yet in the twenty-first century, when most people no longer consider air travel a glamorous adventure and instead find it more of an inconvenience, cruising around Dulles in a mobile lounge offers a taste of the thrill that was once associated with postwar aviation. Passengers still marvel at the architecture of TWA, Dulles and Athens, architecture that expresses the past drama of a now commonplace activity.

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[43] *Development of Athens Airport: Report, 1959. Report by Ammann & Whitney, Engineers, 27. Reports, box 571, folder 1595. Series IV. Project Records, Job 6005: Athens Airport; Terminal Building For Athens Airport (Greece), undated. Presentation booklet by Ammann & Whitney, Engineers, Eero Saarinen & Associates, Architects for Terminal Building and Charles Landrum, Airport Consultant for Terminal Building, 1-7. Reports, box 601, folder 1597. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[44] *Banham 1980 (1960), 329-330.*

[45] *Saarinen, Eero, 1954. The Changing Philosophy of Architecture. Draft of a speech given at the American Institute of Architects, 86th Convention, June 1954. Writings, General Writings, box 28, folder 114. Series II. Professional Papers. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Saarinen 2006 (1959), 346-353.*

1.2. Saarinen's Office as an Architectural Laboratory

> "The new architecture can be likened to a new product not yet on the assembly line, but well under way in the research laboratories. We should look into these laboratories to gain a picture of things to come"[46]
>
> *Eero Saarinen*

This intriguing quote by Eero Saarinen launches this study on a journey that explores his office as a laboratory for a new architecture mediating the modernity of the airport. Eero Saarinen (1910-61), who created his individual work within a limited, albeit intense period of only eleven years, has for decades remained an enigma in the historiography of modern architecture (fig. 1.11). His wide oeuvre is controversial and stylistically diverse, even eclectic, his buildings described as functionalist and technologically progressive, yet simultaneously individualist and artistically expressive. Often Saarinen's approach to architecture is described as "style for the job" and his architecture interpreted in the sphere of its own. Yet, Saarinen's pragmatic approach to design, his client-orientation and commitment to the unique requirements of each project, the re-organization of his office, and the various vocabularies adopted for projects could not be more representative of postwar architecture culture. Indeed, Saarinen's work encapsulates the heterogeneity of unorthodox postwar modernisms.

The problem of Saarinen's placement in the history of modern architecture, if it is a problem at all, is founded in the practice of historians to classify architects according to stylistic cycles. Saarinen, whose style changed with the special needs of each project, creates a classification problem.[47] His heterogeneous oeuvre does not easily fit within the tight matrix of modernism. This is noticeable when Saarinen is traced through the historiography of modern architecture. His occurrence in the histories seems haphazard and his work is mentioned as an example of more than one of the facets of modern architecture. As such his placement in the history is symptomatic of the difficulty to define late modern architecture and his oeuvre a representation of postwar architecture culture in all its heterogeneity.

In what Henry-Russell Hitchcock has called the era of the architecture of bureaucracy,[48] few geniuses were needed and those who aimed to revolutionize mainstream modernism were often accused of eclecticism and commercialism. In the immediate aftermath of the war, Saarinen, like so many second-generation modernists,[49] was searching for new forms to move beyond rationalism. At the same time International Style modernism in its miesian form was increasingly employed to produce glass towers and glass boxes less refined than Mies' Seagram building or Farnsworth House, but

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[46] *Saarinen 1953a, 7.*

[47] *Banham 1975 (1962), 122.*

[48] *Hitchcock 1947, 3-6.*

[49] *This term referred to such younger postwar practitioners as Philip Johnson, Minoru Yamasaki, Wallace K. Harrison and Max Abramovitz, Paul Rudolph, and Edward Durell Stone, who emphasized new construction technologies and variety in forms it enabled them to build. Pelkonen & Albrecht 2006.*

appropriate for corporate architecture spreading across America. Hence, bureaucratic architecture found its counterpart in expressionist, boldly structural, and monumental gestures. Interestingly, Saarinen's contradictory oeuvre seems to include not only the rational but also the eclectic and the commercial, which is partly explained by his frantic search for new expression and a renewed modern vocabulary. It is then perhaps unsurprising that Manfredo Tafuri and Francesco Dal Co have described the mature architectural language of Saarinen as solid professionalism that utilizes bold structuralism and Neo-Expressionism for advertisement. They see this kind of structural expressionism as a resolution to his earlier neurosis of form, and place it within the context of postwar modernism. In their opinion Saarinen's practice was an attempt to restore "meaningful depth to a repertory of inherited forms" that were "devoid of meaning in themselves" after commercialization had displaced modernisms' inherent social and utopian ideals.[50]

Saarinen's generation of postwar architects challenged the modernist orthodoxy through a stylistic eclecticism that eventually led to postmodernism. It is in this vain that Saarinen is often seen as a proto-postmodernist. Yet, this kind of eclecticism might also be seen as a subtle shift in the representation of modernity, which exposed new facets of the modern condition, but did not necessarily negate modernism. Rather, especially in the case of the airport terminal, we may speak of a different kind of modernity, that of transience and networks, which was previously not included in the discourse of architectural modernism. In my opinion, a definition of the work of an architect, who did not have a well-pronounced design philosophy, is perhaps not what is required. Rather, it would be beneficial to view the influence of Saarinen's work in what could be broadly defined as postwar architecture culture and the discourses of modernism. Hence, Saarinen is in this study viewed as a second-generation American modernist, whose office worked as a laboratory experimenting with different kinds of modernisms that coexisted within postwar architecture culture.

Even when canonized in the history of modern architecture, Saarinen's work has received surprisingly little scholarly attention. For four decades a few studies published in the sixties formed the dominant interpretation of Saarinen's oeuvre. *Eero Saarinen on His Work: A Selection of Buildings Dating from 1947 to 1964 with Statements by the Architect*,[51] edited by his widow Aline B. Saarinen in 1962, has been the most influential interpretation of Saarinen's architecture and a source for citations despite their often undocumented primary source. The silence that followed the publication of Allan Temko's (1962) and Rudolph Spade's books (1971) was only disrupted in 2003 by the publication of Antonio Román's *Eero Saarinen: Architecture of Multiplicity*.[52]

More recently, the donation of the Eero Saarinen Papers to the Yale University, Manuscripts and Archives in 2002 has produced a renewed interest in Saarinen's work. Especially Jayne Merkel's *Eero Saarinen* (2005), and the edited collection of scholarly essays *Eero Saarinen: Shaping the Future* (2006) provide a comprehensive picture of Eero Saarinen' work. His corporate architecture is extensively analyzed in Reinhold

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[50] *Tafuri & Dal Co 1979, 378.*

[51] Eero Saarinen on His Work 1962.

[52] *Román 2003; Spade 1971; Temko 1962.*

Martin's *The Organizational Complex: Architecture, Media and Corporate Space* (2003) as well as Alexandra Lange's, John Hardwood's and Nancy Miller's doctoral dissertations. In his PhD thesis Kornel Ringli has also studied the position of the TWA Terminal in the marketing strategy and corporate design of Trans World Airlines.[53] This new research on Saarinen, and its theoretical interest in the stylistic phenomenon often referred to as late modernism or proto-postmodernism enables me to critically contextualize Saarinen's oeuvre in postwar architecture culture and the historiography of modernism.

A wealth of material exists on the Saarinen family that has long fascinated scholars and resulted in publications like Albert Christ-Janer's *Eliel Saarinen* (1951), Marika Hausen, Kirmo Mikkola, Anna-Lisa Amberg and Tytti Valto's *Eliel Saarinen, Projects 1896-1923* (1990) and most recently Timo Tuomi's *Eliel ja Eero Saarinen* (2007).[54] However, I will in this study only briefly discuss the Saarinen family as my interest lies elsewhere, in the analysis of Eero Saarinen's practice as a laboratory for a new architecture. In this study Saarinen's family background, the work he did together with his father Eliel Saarinen or even his famed individual projects are only discussed to the extent that it serves the purpose of demonstrating his understanding of the vocabularies of modern architecture, his success in selling his interpretation of a modernity, and the working methods he employed to design modern airports. Of special interest to me are scholarly attempts to define and place Saarinen within the framework of modern architecture and postmodernism.

Eero Saarinen was born to an artistic family of architect Eliel Saarinen (1873-1950) and Louise "Loja" Saarinen (1879-1968), a sculptor, photographer and interior decorator. Born on the 20th of August 1910 in Kirkkonummi, Finland, Saarinen spent his childhood in Hvitträsk, a family home and architectural office built by his father together with his partners Herman Gesellius and Armas Lindgren in the firm Gesellius-Lindgren-Saarinen.[55] His sister Eva-Lisa "Pipsan" Saarinen Swanson (1905-1979) received an education in the decorative arts and focused in interior and furniture design. She later married architect Robert F. Swanson (1900-1981), who became partner in Saarinen Saarinen Swanson, the firm Eliel Saarinen formed with his son and son-in-law.

The Saarinen family immigrated to the United States following the famed second-prize entry of Eliel Saarinen in the Chicago Tribune Tower Competition of 1922.[56] Having

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[53] Eero Saarinen: Shaping the Future *2006. Harwood 2011; Hardwood 2006. Columbia University, Graduate School of Arts and Sciences; Lange 2005. New York University, Institute of Fine Arts; Martin 2003; Merkel 2005; Miller 1999. University of Pennsylvania, History of Art Department; Ringli 2012. ETH Zurich, Institute for the History and Theory of Architecture.*

[54] *Christ-Janer 1951; Hausen et al. 1990; Tuomi 2007.*

[55] *Eliel Saarinen kept Hvitträsk as a summer home even after the family immigrated to the United States. Tuomi 2007, 49-57.*

[56] *First prize was awarded to John Mead Howells and Raymond Hood of New York. Even though the entry only won second place, its innovative design became influential and Saarinen's widely circulated prints inspired Art Deco styled skyscrapers of the following decades in New York and elsewhere on the American continent. This fame and the prize money enabled Eliel Saarinen to create a second career in the United States. Tuomi 2007, 91-96.*

spent some time in Ann Arbor, Michigan, where Eliel Saarinen served as a visiting professor at the University of Michigan, the family settled in Bloomfield Hills, Michigan following a commission from George Booth (1864-1949), a wealthy Detroit-based businessman, publisher of the *Detroit News*, admirer of Eliel Saarinen's work, and founder of the Cranbrook School and Academy of Art. Eliel Saarinen designed the Cranbrook campus (1925-1942) and became head of the Cranbrook Academy of Art, which attracted several talented designers, including Ray Kaiser (1912-1988, later Eames), Charles Eames (1907-1978), Florence Schust (later Knoll Bassett, 1917-), Harry Bertoia (1915-1978), Ralph Rapson (1914-2008), and Lilian "Lily" Swann (later Saarinen, 1913-1995). They all worked with Eero Saarinen thus forming the initial network of his collaborators.[57]

After his training in Cranbrook and his father's studio, it was obvious that Eero Saarinen would choose a career in the creative arts.[58] He attended Académie de la Grande Chaumière in Paris the academic year of 1929-1930 and was awarded Bachelor of Fine Arts in Architecture from the Yale School of Architecture in 1934. It seems that the parents desired to educate their son in one of the leading academic institutions of the new continent, yet within the traditional École des Beaux-Arts curriculum since Eliel Saarinen wrote to dean Everett Victor Meeks to request a place for his son.[59]

The Beaux-Arts curriculum, under which Saarinen was trained, emphasized solving modern design problems with historic prototypes. This curriculum dominated the American design schools until the end of the 1930s when it was replaced by a modernist program.[60] Despite Henry-Russell Hitchcock, Philip Johnson and Alfred Barr having introduced modern architecture in the Museum of Modern Art exhibition of 1932, the transfer from classical to modern architecture programs in the design schools evolved only slowly. At the end of the decade European modernists immigrated to the United States and their presence accelerated this transfer. For instance, Ludvig Mies van der Rohe left Europe in 1938 and became director of architecture at the Armour Institute of Technology,

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[57] *Coir 2006, 30-32.*

[58] *Eero Saarinen started his career early, working on details and furniture design for the Cranbrook School for Boys (1925-1931) and the Kingswood School for Girls (1929-1931), and producing architectural models of his father's projects; Core ca. 1952. The date and name of the newspaper are missing from the copy at the Cranbrook Archives, but it is assumed that the publication is* Birmingham Eccentric *and the date 1952; Louchheim 1953, 26.*

[59] *At Yale Eero Saarinen studied under Otto Faelten, Carroll Meeks, Theodore Sizer, Raymond Hood, Deane Keller and Theodore Crane. Pelkonen et al. 2006, 325-326.*

[60] *Zeynep Çelik Alexander has recently analyzed the epistemological change involved in the transfer from the Beaux-Arts to the modern curriculum. She claims that* Kennen *(tactile knowledge) replaced* Wissen *(theoretical knowledge) as the emphasis shifted from copying historic prototypes into studies on form. This happened first in the German independent art schools, which were important predecessors of the* Vorkurs *in Bauhaus. Saarinen's education is a curious mixture of both approaches. He studied at Yale under the Beaux-Arts curriculum, but he was also trained at Cranbrook, where the curriculum was based on workshops that students took regardless of their major (ranging from architecture or weaving). Cranbrook's curriculum thus resembled that of the German art schools and the* Vorkurs *in Bauhaus. Alexander 2009, 203-226; Alexander 2010, 50-83.*

later Illinois Institute of Technology (IIT), where he designed the campus and its famed School of Architecture, the S. R. Crown Hall (1950-56). Walter Gropius, Marcel Breuer and Martin Wagner joined Harvard faculty after Joseph Hudnut became dean of the Harvard School of Design in 1935. Other modernists on the American continent included Sigfried Giedion, who was a frequent lecturer at Harvard; Laszlo Moholy-Nagy, who became director of the New Bauhaus in Chicago in 1937; and Joseph Albers, who was teaching at Yale.[61] Thus, Saarinen's training in the Beaux-Arts tradition was not atypical of the time, but definitely significant when one considers the historicist tendencies in his architecture. However, the progressive atmosphere of Cranbrook, his studies in sculpture in Paris, and exposure to European modernism through family connections and travel, balanced these influences.[62]

Eero Saarinen's early work experience is evidence of how his training at Yale, the network he had established there and at the Cranbrook Academy of Art, and his father's position in the architectural field facilitated his fast career progression. In 1938 he was invited by his Yale classmate Worthen Paxton to work in the office of the industrial designer Norman Bel Geddes. There Saarinen contributed to the General Motors' New York's World Fair pavilion *Futurama* (1939), which, perhaps significantly considering his later production of corporate campuses and transportation infrastructure, was an installation of highways and suburbs that visitors viewed from an elevated conveyer belt.[63] Geddes's methodological approach, which relied on quantifiable data and functionality studies, was also influential to Saarinen's systematic approach to architecture.[64] In 1940 Saarinen participated with Charles Eames in the Organic Design in Home Furnishing competition organized by the Museum of Modern Art, and won two first-place awards for molded-plywood chairs and case goods. Eero Saarinen also joined the Cranbrook faculty to teach city planning between 1939 and 1941. During the World War II he served as a civilian consultant for Presentation Division of the Office of Strategic Services (OSS) –the precursor of Central Intelligence Agency (CIA) –in Washington D.C., where he worked along several of his Yale classmates as well as his future collaborators Dan Kiley and Oliver Lundquist.

Throughout his early career Eero Saarinen continued to work with his father and brother-in-law Robert Swanson in the firm Saarinen Swanson Saarinen, which, after Swanson left the office in 1947, was called Saarinen Saarinen Associates until the death of Eliel Saarinen in 1950.[65] The most notable projects on which Eero Saarinen collaborated

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[61] Ockman 1997, 124.

[62] After completing his studies Saarinen travelled to Egypt, Greece, Syria, Palestine, Italy, Germany, France, Sweden and Finland in 1934-1935 with the support of the prestigious Charles Arthur and Margaret Ormrod Matcham Traveling Fellowship for European travel. He was especially impressed by the work of Mies van der Rohe and Mendelsohn, Le Corbusier, Gunnar Asplund and Alvar Aalto. Travel photographs, boxes 8-9, folders 96-101. Series I. Personal Papers. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.

[63] Merkel 2005, 43; Pelkonen & al. 2006, 327.

[64] Peter Papademetriou discussion with Thomas Fisher 1992, 102-104; Roman 2003, 111.

[65] Merkel 2005, 50; Pelkonen et al. 2006, 328-329.

with Eliel Saarinen include Crow Island School in Winnetka, Illinois (1938-42), and the unrealized Smithsonian Gallery of Art for Washington, D.C. (1919-39), both of which featured in the Museum of Modern Art's exhibition and publication *Built in USA: 1932-1944* (1944).[66] However, the son's contributions remained subordinate to the father's in these commissions, and it is difficult to trace the extent to which he designed the projects as they are clearly done in the style of the senior Saarinen. While Eero Saarinen had long worked independently on projects such as Case Study Houses #8 and #9 for the *Arts & Architecture* (1945 with Charles Eames),[67] and the Womb Chair (1946-1948),[68] his individual career was jumpstarted only by the United States Jefferson National Expansion Memorial competition (1947), where he received the first prize together with his team including Dan Kiley, Lilian Swann, J. Henderson Barr and Alexander Girard. This modernist monument was to become not only the symbol of St. Louis and modern technology, but also the cornerstone of Saarinen's reputation.[69]

Obviously, the legacy of Eliel Saarinen to his son was tremendous and perhaps best summarized by the title of Aline B. Louchheim's (1914-72, later Saarinen) well-known article "Now Saarinen, the Son."[70] Eliel Saarinen was a famed architect and an admired educator, who taught his son to be a committed and focused professional. Yet, there were significant differences in the aims and design methods of the two architects.[71] Both emphasized being men of their time but, as Jayne Merkel has noted, Eero Saarinen was a man of the second half of the twentieth century in a manner that Eliel Saarinen was a man of the first half of that same century. Eero Saarinen was a technical innovator, whose architecture interpreted historic sources whereas Eliel Saarinen was forward-looking but

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[66] Built in USA *1968, 24-25, 74-75.*

[67] *The editor of* Arts & Architecture *John Entenza initiated the program. Participants included Richard Neutra, William Wurster and Theodore Bernardi, Craig Elwood, Pierre Koenig, Ralph Rapson, and Raphael Soriano. The Houses number 8 and 9 were first published in* Arts & Architecture*, December 1945, 43-51, but Ray and Charles Eames redesigned house number 8 (known as the Eames House) during the building process. Merkel 2005, 63.*

[68] *Series IV. Project Records. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Inventory of Buildings and Projects 2006, 121-160; Merkel 2005, 53, 56-67.*

[69] *Lipstadt 2006, 223-229; Louchheim 1953.*

[70] *Eero Saarinen commented on the draft of the article. Correspondence: Eero Saarinen to Aline Saarinen, 1953, Box 2, Folder 26, undated letter, 11-15. Aline and Eero Saarinen Papers, 1906-1977. Archives of American Art, Smithsonian Institution; Louchheim 1953, 26.*

[71] *Cranbrook reunion transcript. Saarinen/Swanson Reunion Records, 2001-14, box 3. Cranbrook Archives. Eliel Saarinen's design philosophy often took a form of aphorisms such as "always follow the next big thing," which Eero Saarinen formulated as, "In any design problem one should seek the solution in terms of the next largest thing. If the problem is an ashtray, then the way it relates to the table will influence its design. If the problem is a chair, then its solution must be found in the way it relates to the room." Larrabee &Vignelli 1981, 57.*

not an avant-garde modernist, who would experiment with industrial materials or expose raw concrete like his son.[72]

Unlike his father, Eero Saarinen never wrote extensively, neither gave many public speeches.[73] Nevertheless, his design philosophy can be traced in interviews done with former employees, surviving correspondence,[74] and some published articles, speeches and unpublished statements[75] that form the corpus of his architectural thinking. Instead of architectural treatises Saarinen's practice took the form of relentless hours spent by the drafting table and in the model shop. He used his persuasive talent to convince clients of even the most controversial design ideas that often included an innovative structural solution, new materials or an unforeseen form, a "first" in architecture. These in turn functioned as advertisement for the corporate clients who recognized their value as such.

An interesting project demonstrating the difference between Eliel and Eero Saarinen is the General Motors Technical Center (GMTC, 1948-56), which underwent several design stages and featured in the second *Built in USA: Postwar Architecture* exhibition and book (1952).[76] The first schemes for the project were done in the style of Eliel Saarinen, but the son designed the final scheme of the industrial campus. Actually, General Motors Technical Center is the project that placed Saarinen in the front line of the second-generation modernists. The "Industrial Versailles," as it was called in the press,[77] was suppose to be seen from a car driving 30 mph. It was the first example of a suburban office campus, which was to become the organizational complex of postwar corporate

[72] *Both architects emphasized being men of their time. Eero Saarinen, for instance, stated: "I am a child of my period." Saarinen 2006 (1959), 349; Merkel 2005, 28-29.*

[73] *Eliel Saarinen's literary oeuvre was wide and included influential publications such as Saarinen, Eliel 1943; Saarinen, Eliel 1948.*

[74] *Saarinen maintained correspondence and discussed his work with Swedish textile designer Astrid Sampe. Astrid Sampe Collection of Eero Saarinen Correspondence, 1948-1960. Cranbrook Archives. In a letter to Aline B. Saarinen he for instance lists architects, "whose approval but not necessarily agreement one would like to have" as Eliel Saarinen, Charles Eames, Mathew Nowicki, Mies van der Rohe, William Wurster and Philip Johnson, albeit he lists also other names and is somewhat undecided about the order of the most important ones. Correspondence: Eero Saarinen to Aline Saarinen, 1953, Box 2, Folder 26, undated letter, 14. Aline and Eero Saarinen Papers, 1906-1977. Archives of American Art, Smithsonian Institution.*

[75] *Examples include published articles such as Saarinen 1953b, 110-115. Drafts of several speeches, articles and statements like "Main Currents in Mid-Century Architecture" (1953), "Golden Proportions" (1953), "The Changing Philosophy of Architecture" (1954), "General statement about the sculptural, curved shapes that we have been involved with, beginning with St. Louis, the water tower and dome at General Motors, MIT, Yale, TWA, and now the Washington International Airport" (ca. 1958), "Dickinson College Arts Award Address" (1959), and "Benjamin Franklin Lecture Series speech at the University of Pennsylvania" (1960) are found in Presentations and lectures, box 21, folders 70-78; General writings, box 28, folders 114-121. Series II. Professional Papers. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[76] Built in USA *1968, 94-97.*

[77] *GM's Industrial Versailles 1956, 123.*

culture. In GMTC Saarinen was able to combine his understanding of total environments with his experience in campus design and his interest in modern technology, new materials and industrial processes. He reinterpreted the project's miesian façades with the use of colorful, orange and blue glazed tiles at the shorter walls of the buildings and applied his newly accumulated knowledge from the automobile industry in placing the windows and metal panels in neoprene gaskets. The building was then exemplary of Saarinen's approach to design as it utilized progressive technology to reinterpret modern architecture and express corporate identity.[78]

In fact, Donald Albrecht argues that Saarinen utilized the design and public relations strategies he had developed for the General Motors project as a template for future commissions. This template comprised the creation of iconic architectural forms for each client, the commission of site-specific artworks, and the development of technological and planning innovations. He thus created buildings that became major components of the company's branding and publicity.[79] "When you see client-orientation of this kind," claimed Reyner Banham, "you realize there was no irony in his work for G.M. at all –it was the building Harley Earl wanted. Like a good advertising agency, Eero really serviced his clients, and in finding for them the 'unique solution' he did, fairly painlessly and without short-calling anybody's cultural standards, exactly what David Ogilvy has to knock himself out to do in advertising –he bestowed status, improved the image."[80]

The fame of the GMTC attracted corporate clients to Saarinen, who subsequently reshaped his office into a successful postwar architectural laboratory. As the firm's fame increased, Saarinen assessed his success in 1952: "I have until recently had a reputation as being one of the best younger architects. The publication of General Motors Technical Center put me about half way between that category and being 'successful' with big business (and also good). Skidmore Owings & Merrill and Harrison have been the two firms in this last category. If Time comes to us it really means that we will be thought of as the third firm on that plane."[81] Subsequently, in 1953 Saarinen built a new office building for his growing practice. This two-story modular brick-and-glass building was a purpose-built, laboratory-like facility that formed open, functionally light and transformable working spaces and importantly provided a model shop for Saarinen's innovative working method. Increasingly the firm was approaching architectural problems with a scientific mindset and experimented with models to achieve an appropriate aesthetic expression. As the working methodology crystallized so too Saarinen's practice was developing a growing reputation among emerging young architects, and many talented individuals such as Cesar Pelli, Kevin Roche, and Robert Venturi passed through

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[78] *Lange 2006, 278. Martin 2003, 157-181.*

[79] *Albrecht 2006, 47.*

[80] *Banham 1962a, 73.*

[81] *Eero Saarinen's letter to Astrid Sampe, undated, ca. 1952. Astrid Sampe Collection of Eero Saarinen Correspondence, 1948-1960, box 1, folder 5, letter 2. Cranbrook Archives. Although Saarinen had become one of the few architects, who have ever been featured in the cover of the* Time *magazine (in a number that included the story The Maturing Modern), the reference to Time in this quote meant an unrealized project for Time Inc. headquarters. Albrecht 2006, 46-47;* Time*, July 2, 1956, 50-57.*

his office before creating careers as prominent architects on their own right. Therefore, if Saarinen's buildings were creating nodes in the expanding networks of business, his office was very much a node in the networks of architectural knowledge production.

Indeed, the bulk of Eero Saarinen's oeuvre is in corporate and university campuses and –airports. His architecture then forms what could be defined as seminal nodes within the suburban network. His clients included universities such as Yale and Massachusetts Institute of Technology (MIT),[82] and big businesses such as General Motors, International Business Machines (IBM), Columbia Broadcasting Systems (CBS), and Deere and Company. The research centers he created for IBM and Bell Telephone Laboratories together with his university buildings formed centers in the modern networks of knowledge. Furthermore, he was involved in giving visual form to the postwar era and designed some of its most exciting projects: corporate campuses and laboratories, university buildings, airports, embassies, and even one metropolitan skyscraper. These were the quintessentially modern building types that organized modern societies, living environments, learning and knowledge production, and reflected the contemporary, unquestionable faith in technology and science, democracy and capitalism. Saarinen even participated in the United States embassy building program, which was based on the assumption that modern architecture could advance democratic values and capitalism in the world divided by the Cold War[83].

Saarinen's architecture encapsulated the experience of modernity and faith in new technologies at the time, when the United States was becoming a leader in economics, culture, technology and education. He partook in the shaping of what has been named the "American Century."[84] As Louchheim observed, Saarinen's contribution was "in giving form or visual order to the industrial civilization to which he belongs, designing imaginatively and soundly within the new esthetics which the machine age demands and allows. His buildings, which interlock form, honest functional solutions and structural clarity, become an expression of our way of life."[85]

Unfortunately Saarinen's untimely death in 1961, after an unsuccessful brain tumor operation, leaves one wonder where his search for new expression had eventually taken him. The controversy about Saarinen's architecture is perhaps most accurately expressed in the reserved evaluations published by contemporary critics. "The Yale College and the [Dulles] Airport would seem to establish him as one of the great 'makers' in architecture

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[82] *Eero Saarinen designed several highly appreciated university buildings such as the University of Chicago Law School (1955-60), The Samuel F. B. Morse and Ezra Stiles Colleges (1958-62) and David S. Ingalls Hockey Rink (1956-58) for Yale University, and the Kresge Auditorium and Chapel (1950-55) for Massachusetts Institute of Technology. Universities needed new buildings to meet the growing demand for higher education. The GI Bill offered some fourteen million returning veterans a chance to study while a growing number of women were also enrolling in colleges. Merkel 2005, 103.*

[83] *Jane Loeffler has described the embassy-building program and its aims. Loeffler 1990.*

[84] *Henry R. Luce, the founding published of* Time, Fortune *and* Life *magazines called the postwar decades the American Century in 1941: "The world of the 20th century, if it is to come to life in any nobility of health and vigor, must be to a significant degree an American century." Luce 1941, 64.*

[85] *Louchheim 1953, 26.*

of our day," claimed Henry-Russell Hitchcock, "they epitomize, in their apparently totally dissimilar modes, despite their essentially identical material, the vitality and variety of all his production and also, perhaps more significantly, the basic ambiguities of current architectural development."[86]

"Injustice was certainly done," wrote Reyner Banham, "suspect any man who claims that his record on Saarinen is clean, or any man who insists too loudly that Saarinen was a really great architect. Both are already possessed by Eero's mana… and I have to confess that my own record has some dirty patches. But I still stick to the general view of Saarinen that I have held all along. He was never a really great architect, and I have some reservations on practically every building he did. But only *some,* and those not enough to detract from the fact he was a darned good designer who left a stamp of stunning professional expertise on everything he did."[87] Very farsightedly Banham further observed: "It was not a style he had to offer. It was an extraordinary degree of adaptability that may in the end prove more interesting than the buildings themselves."[88]

Indeed, Saarinen's adaptability well encapsulated the heterogeneity of postwar architecture culture. Saarinen's buildings mediated modernity. They were constructed for people who imagined themselves primarily as modern spectators and individuals collaborating in the new networks of science, technology, business and transportation. In this study these novel networks are explored through the three airport terminals Eero Saarinen created toward the end of the fifties.

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[86] *Hitchcock 1962, 13-16.*

[87] *Banham 1962a, 73.*

[88] *Banham 1962a, 73.*

2. Technology and the Historiography of Modern Architecture

The three airport terminals created by Eero Saarinen, surface several questions concerning postwar modern architecture and its relation to progressive technologies. In order to understand the specific relationship between architecture and technology it is quintessential to ask: What is architectural modernism? What is technology, and how does modern architecture relate to it?

In the light of the historiography of modern architecture and the various forms architectural modernism has taken, it is evident that there is not a single architectural modernism, but rather a diversity of modernist discourses. The interpretation of modernity and technology inherent in these discourses has significantly changed over the decades in response to the context of not only building, but also architectural history writing. Therefore, in this study I assume that there is a plurality of modernist discourses and study them for their specificity. Following Michel Foucault's definition of genealogy, I approach the historiography of modern architecture examining the emergence of new interpretations of modernity and technology as events. These events then form a series of dominations and reversals that could be studied as the changing discourse of modern architecture. This kind of an approach does not presume a linear development of architectural modernism, but rather assumes discontinuity, ruptures, and reversals of power in the discourse.[89] Hence, my approach to modern architecture is archeological in the sense that it aims to recover what was meant by modernity and technology in the fifties and sixties.

2.1. Defining Modernity

The plurality of modernisms is evident when first, architectural modernism is analyzed in relation to modernization and modernity; second, different concepts referring to modern architecture are examined; and third, the historiography of modern architecture is studied for its discursive formation.

First, the plurality of modernisms needs to be defined in relation to the concepts of modernization and modernity. For my use of these terms I rely on Marshall Berman. He describes modernization as a process of social development characterized by industrialization and technological advances, urbanization and demographic upheavals, the rise and bureaucratic organization of powerful national states, expansion of mass communication systems, democratization, and expanding capitalist world market. Modernity denotes the typical features of the world thus modernized, and the experience of an individual amidst continuous change and progress toward a future radically different from the past and the present. Modernity is then the only solid source of meaning in a world of contradiction and constant transformation, disintegration and ambiguity, but also

[89] *Foucault 1998 (1971), 369-391.*

excitement, dynamism and progress. It gives rise to modernism, which refers to the ideas and movements that enable women and men to intellectually understand the process of modernization, the condition of modernity, and control the changes they are subjected to. Hence, modernity is the condition caused by the process of socioeconomic development known as modernization and the source of subjective responses taking the form of modernist discourses and cultural movements. The plurality of modernisms results from a variety of definitions given to the concept of modernity. And these modernisms have received various architectural expressions.

Berman divides the history of modernity into three phases. The initial phase of modern life lasted from the sixteenth to the nineteenth century, but did not yet possess a sufficient vocabulary to describe modernity. The second phase was initiated with the revolutions of the 1790s and characterized by a feeling of living the revolution but still belonging to a pre-modern world. The ideas of modernization and modernism emerged from this dichotomy of living in two different worlds simultaneously. Twentieth century was the third modern phase. It experienced the expanding process of modernization that fragmented the modern public and shattered the idea of modernity into a multitude of interpretations unable to organize and give meaning to people's lives. In Berman's opinion the nineteenth century modernists were ironic and affirmative even when they criticized the modern environment whereas the twentieth century theories of modernism are negative, inadequate, and have lost their capacity to view modern life with critical enthusiasm or power to influence it.[90]

Hilde Heynen has further defined four different concepts of modernity. She claims that the concept of modernity inherent in the modern movement was primarily programmatic and pastoral whereas the concept of modernity found in critical theory[91] was transitory and counterpastoral. The programmatic concept of modernity viewed modernization as continuous and unproblematic positive progress resulting in emancipation and a radically different future. In contrast, the transitory concept of modernity viewed modernization as constant change and crisis leading to fragmentation, plurality, and, eventually, to the exhaustion of the modern project and the postulation of the postmodern condition. It emphasized the transient and momentary character of modernity. The counterpastoral concept of modernity was based on a fundamental discrepancy between the economic modernity of capitalist civilization and the aesthetic modernity of modernist culture. In this view modernity meant the collapse of integrated experience, and the irreversible autonomy of various domains unable to regain their common foundation. The opposing pastoral view of modernity was naïve and uncritical. It aimed to harmonize the conflicts

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[90] *Berman's "All that is solid melts into air" is a citation from Marx, whose holistic, dialectic view is in Berman's view lost in the later discourse that is unable to address both the economic process of modernization, and cultural modernism. Berman 1988 (1982), 15-17, 21, 24; Engels & Marx 1972 (1848), 338.*

[91] *In this study, I follow Hilde Heynen's loose definition of critical theory, which includes not only the Frankfurt School authors such as Max Horkheimer, Theodor W. Adorno and Herbert Marcuse, but also Walter Benjamin and Manfredo Tafuri. See for instance Horkheimer & Adorno 2002 (1944); Heynen 1999, 3, note 2.*

and contradictions caused by modernization and gave capitalist civilization and modernist culture a common denominator ignoring any underlying conflicts and contradictions. Politics, economics and culture were then united in harmonious progress.[92]

While the transitory and counterpastoral view was typical to some avant-garde architects and especially the protagonists of postmodernism, the historians and architects of the modern movement supported the pastoral and programmatic concept of modernity. Their political views were conformist or only moderately reformist. Hence, Heynen claims that it is conceptually incorrect to call the modern movement avant-garde, because it neither reached the level of political radicalism found in the other avant-gardes, nor addressed the experience of disintegration, alienation and displacement caused by constant change and rationalization. Historians (with the exception of Manfredo Tafuri) never asked how architecture should confront modernization or reconcile modern culture with capitalism despite the fact that critical theory empowered architecture with a potential to reorganize environments and visualize the fragmented condition of modernity.[93]

In this study I argue that the historians of the modern movement did not notice the airport terminal because of the programmatic and pastoral concept of modernity inherent in the writing of architectural history. The airport terminal is a transitory, fleeting space that corresponds with modernity's transitory character. Therefore it was the modernity rather than the novelty of the building type, which made it alien to the narrative of modern architecture. The airport terminal was associated with the modernization of transportation and the progressive modern technology of aviation. The movement associated with the airport, albeit exciting and futuristic, was also fragmenting, and displacing. The aircraft was able to move people beyond any visible geographical distance in a matter of hours, which was something previously conceived only by the locomotive pulling cars along very visible and measurable railroad tracks. The airport terminal was thus associated with internationality and new meanings given to time, space, speed, distance, and direction[94]. What is more, airport terminal's movement was not solely movement of aircraft, people and goods, but also movement of the airport as circulation of imaginaries.

The airport organized movement between destinations that were increasingly becoming non-places in the matrix of air routes. And it was precisely this non-place quality of the airport terminal that made it daunting. In his definition of a non-place Marc Augé identifies supermarkets, garages and airports as anonymous and identical spaces that in his view lack history, identity and social relations. They are spaces that one passes through instead of anthropological places.[95] However, one could also argue that the airport is a recognizable place, when it is not considered as a node in the networks of transportation, but instead seen as a landmark to the community it serves. In my opinion, it is this dual function of the airport terminal as node and place, transport interchange and public space, that has made it difficult to place the terminal within the history of modern architecture.

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[92] *Heynen 1999, 11-13.*

[93] *Heynen 1999, 26-29.*

[94] *Kern 2003 (1983).*

[95] *Augé 1995.*

Second, architectural modernism is often defined as the new architecture of the 1920s and 1930s including buildings and projects as well as their reception and legacy until the late 1960s paradigm shift to postmodernism.[96] However, modernism was not the dominant style of the interwar period,[97] and its cultural variants make not only the dating but also the definition of modern architecture ambiguous.[98] "Modern" may refer to contemporary architecture of any period, and therefore modern architecture and parallel terms are always defined by the context of usage. Keeping this in mind, it is important to distinguish the "modern" utilized in the histories of modern architecture from the language of analysis. Reinhart Koselleck suggests that this is achieved with the aid of conceptual history, which detaches concepts from their situational context and studies their changing meanings and modalities of usage in time.[99]

Functionalism and the modern movement, rationalism and International Style are among the key terms of modern architecture. While functionalism and the modern movement are exclusively used for the architecture of the twenties and the thirties, rationalism and International Style may refer to postwar architecture in a rationalist style derived from functionalism. Rationalism, in turn, is defined by standardization, rationalization of production, utilization of latest technologies, and their aesthetic expression. Its main aesthetic features are strip windows and curtain walls, evenly divided façades, pronouncedly horizontal or vertical lines, sparse detail, overlapping of interior and exterior spaces, and especially in the fifties the use of experimental façade materials. International Style is a term derived from the book Henry-Russell Hitchcock and Philip Johnson published in conjunction with the exhibition they organized at the Museum of Modern Art in 1932. It aimed to politically neutralize modern architecture from the socialist content associated with European functionalism in order to introduce modern architecture to the United States.[100] In the postwar context International Style referred to the normative, apolitical, mainly aesthetic, geographically and culturally dispersed modern architecture. It was contradicted by a number of alternative interpretations of modern architecture such as New Brutalism, New Humanism, New Formalism and New Regionalism with their distinct architectural vocabularies.[101]

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[96] *See for instance Forty 2000; Heinonen 1986 (1978); Tournikiotis 1999.*

[97] *For instance, only 24 architects from eight countries participated in the first meeting of* Congrès Internationaux d'Architecture Moderne *(CIAM) in La Sarraz in 1928 while 130 architects from 18 countries partook in the second meeting in Frankfurt in 1929. Hundred delegates were present in the 1933 CIAM meeting, where* The Athens Charter *(summarizing modern town planning ideals) was drafted. Le Corbusier 1973 (1943); Mumford 2000, 9, 34, 77.*

[98] *For example the use of* Neue Sachlichkeit *and* Neues Bauen *was limited to specific linguistic areas, but their emphasis on building over architecture had implications for the definition of modern architecture. Heynen 1999, 28, note 10.*

[99] *Koselleck 2004 (1979), 81-91.*

[100] *Hitchcock & Johnson 1995 (1932); Forty 2000, 187.*

[101] *It should be remembered that of the first-generation modernists Le Corbusier, Walter Gropius and Ludwig Mies van der Rohe were still working in the postwar years. Modern architecture was redefined in*

In this study I use modern architecture to refer to the architecture emerging in the twenties and developing until the late sixties. However, the aim of this study is to critically view this definition by juxtaposing it with the "modern," which it excluded. The histories of modern architecture advanced a specific modern architecture and did not acknowledge such variants of modernism as streamlined modern or Art Deco. This, in part, explains why the airport terminal was not noticed when the canon of influential modern buildings was formulated. The architectural style of the interwar airport terminals was not avant-garde modern. Rather, it corresponded to the various vocabularies selected for other, similar building types. Thus, such terminals as Dirk Roosenburg's Schiphol Airport in Amsterdam (1929), Paul Hedquist's Stockholm-Bromma Airport (1935-36) and Gianluigi Giordani's Milan-Linate Airport (1935-37) could have been included in the canon of modern buildings if modernism was defined to include regional variants like the Amsterdam School, Scandinavian modernism and Italian rationalism.

Third, the historiography of modern architecture consists of a number of histories written between the 1920s and the 1960s –simultaneously with the architecture they documented. The historiography then incorporates not one, but many interpretations of modern architecture (even by the same author), and various canons of documented buildings. The pioneering histories were Adolf Behne's *The Modern Functional Building* (1926), Sigfried Giedion's *Building in France, Building in Iron, Building in Ferroconcrete* (1928), Henry-Russell Hitchcock's *Modern Architecture: Romanticism and Reintegration* (1929), Emil Kaufmann's *Von Ledoux bis Le Corbusier: Ursprung und Entwicklung der autonomen Architektur* (1933), and Nikolaus Pevsner's *Pioneers of the Modern Movement from William Morris to Walter Gropius* (1936). In the sixties the genealogy and canon of modernism was revised in the histories such as Reyner Banham's *Theory and Design in the First Machine Age* (1960), Peter Collins' *Changing Ideals in Modern Architecture, 1750-1950* (1965), and Manfredo Tafuri's *Theories and History of Architecture* (1968). Seminal histories of the modern movement –Giedion's *Space, Time and Architecture: The Growth of a New Tradition* (1941) and Hitchcock's *Architecture: Nineteenth and Twentieth Centuries* (1958) –were also significantly revised and enlarged over the decades.

In this study I concentrate on the plurality of postwar modernist discourses exemplified by Giedion's *Space, Time and Architecture*, Hitchcock's *Architecture: Nineteenth and Twentieth Centuries*, Banham's *Theory and Design in the First Machine Age,* and Tafuri's *The Sphere and the Labyrinth: Avant-Gardes and Architecture from Piranesi to the 1970s* (1980).[102] I acknowledge that by selecting these histories, other, equally interesting interpretations of modern architecture are excluded from this study and that these histories –especially the work of Peter Collins, William Jordy, Nikolaus Pevsner, Vincent Scully, and John Summerson –represent different approaches to technology than the one

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their production along the work of the second-generation modernists. On the diversity of modernism see the collection of period writings Architecture Culture 1943-1968, *1993.*

[102] *While Giedion's, Hitchcock's, and Banham's histories have been chosen as the most representative history by the author, a later history by Tafuri is chosen, because in it Tafuri develops the idea of "architectural" microhistory.*

noticeable in the discursive development traced out in the selected histories. However, the aim of this study is to question the techno-determinism evident in some, arguably highly influential and even dominant, histories of modern architecture. Furthermore, while I acknowledge the expanding canon of modern architecture, the purpose of this study is not simply to add buildings to the already established canon, a list of influential buildings that would only be extended by such a gesture. Rather, and instead of treating modern architecture itself as constant, I study variation in the definitions given to modernity and technology in the selected histories in order to understand why the airport terminal was excluded, and what such exclusion reveals of the airport terminal and the historiography.

A comparative reading of these histories reveals the narrative nature of history writing. Historians necessarily interpret and reconstruct events out of archival material and layers of written documentation. History writing relies on subjective choices the narrator makes when reconstructing not only the historical events, but also their sociopolitical and cultural context. Thus, in the historiography of modern architecture the emphasis placed on architects, buildings, events and ideas varies according to the questions the historian asked of his material. Out of necessity something is always excluded to secure an integral interpretation. As Marc Bloch reminds us, the historian always arrives after the experiment has been concluded, but the experiment leaves behind residues, which can be seen and analyzed in the laboratory of the historian. The historical documents discovered only speak if properly questioned, cross-examined and assembled into a coherent whole that reveals interrelations.[103]

In this sense historians work in laboratories not unlike the architectural laboratories interpreting modernity in the 1950s. Yet, it is not only the act of writing that influences the interpretation. Architectural modernism is equally redefined in the act of reading and shaped by the interpretive framework of the reader.[104] Hence, taking account of both the act of writing and that of reading, and the act of building and that of viewing and using[105] buildings, it is possible to trace changes in architectural modernism and reconstruct the various forms it has taken not only in the built environment but in the annals of modern architecture. Importantly one needs to ask, why a certain form of architectural modernism was enforced at a given time, why some phenomena were overlooked, and why a specific research question was found compelling only later?

Answers to these questions together with the built environment and the historiography of modern architecture constitute what could be called the changing discourse of modernism. Postwar architecture culture was defined by a diversity of modernisms, the discursive formation of which can be analyzed in the historiography. As Michel Foucault defines it, discourse is a group of statements belonging to a single system of formation and

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[103] *Bloch 1953, 54, 64-65.*

[104] *Carr 1982, 22-25, 44, 105.*

[105] *This study does not include research on the use of buildings (e.g. interviews with air carriers and travelers utilizing the airports), but it discusses how the designers studied user patterns and how the airport terminals were later expanded and altered based on expanding volumes of travel and related user requirements. User studies based on interviews would be an intriguing topic for future research on the airport terminal.*

practice, obeying rules that could be studied with what he calls the archeology of knowledge. This is a comparative analysis that differentiates between levels of events within discourse: its statements, appearance of objects and enunciations, new rules of formation, and substitution of one discursive formation with another. Instead of looking for origin, it describes gaps, discontinuities and ruptures within the discourse. This is because the apparent unity of discourse is actually a dispersion of elements that can be described if one is able to determine the rules in accordance with which objects, statements, concepts and strategies are formed. Knowledge is then defined as that of which one can speak taking certain positions within a discursive practice.[106]

In this study I treat histories, following Foucault, as discursive "practices that systematically form the objects of which they speak."[107] However, in contrast to some studies I do not view histories as isolated texts. Specifically, Maristella Casciato has criticized historiography studies such as Panayotis Tournikiotis' *The Historiography of Modern Architecture* for a tendency to dismiss the social and cultural context of the writer in favor of the discourse.[108] In response, recent historiography studies have adapted a more biographical view of the historian and discussed the historiography with an emphasis on the context.[109] For instance, Anthony Vidler in *Histories of the Immediate Present: Inventing Architectural Modernism* concentrates on a specific moment or a group of writings by the author (historians are Kaufmann, Colin Rowe, Banham and Tafuri) between the years 1945 and 1975 that he defines as a period of intense discussion on architectural modernism. As Vidler claims, writing of history forms a comprehensive practice immersed in the theory and design of architecture that "as it embraces all aspects of architectural field, might properly be called its 'discourse.'" Hence, it is of importance to not only analyze the context of the historians' intellectual formation but also to examine the specific modernism advanced by their historical narratives, and the influence these narratives and proposed models had on practice.[110]

2.1.1. The Genealogy of Modern Architecture

The plurality of postwar modernisms was linked to a transfer from a programmatic discourse to a questioning one. In this study I differentiate between the programmatic, questioning and neutral discourses, which correspond to the operative, derogative and objective discourses employed by Panayotis Tournikiotis.[111] Tournikiotis views the

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[106] *Foucault 1972 (1969), 72, 138, 171, 182*

[107] *Foucault 1972 (1969), 49.*

[108] *Casciato 2002, 298-305, especially 299; Tournikiotis 2003, 290-297, especially 296; Tournikiotis 1999, 5-6.*

[109] *See for instance Hoekstra 2005. Rijksuniversiteit Groningen; Vidler 2008.*

[110] *Vidler 2008, 14, 201-202.*

[111] *Tournikiotis's analysis is influenced by his mentor Françoise Choay's semiotic structuralism. The social, political and economic context is removed from Tournikiotis' study, which concentrates on the discursive formation of modern architecture. Tournikiotis 1999, 5-6, 14-16, 222-225.*

histories of modern architecture as attempts to interpret contemporary architecture through historical analysis, and defines the three discourses according to their inherent concepts of history and architecture, and the relationship between architectural vision and social reform. Complementing Tournikiotis' approach, I view these discourses in terms of their inherent concepts of modernity and technology. In particular, I utilize methodologies derived from Science and Technology Studies, and read the historical narratives in relation to the imagery of "the machine" and the actual contemporary technologies exemplified by the aircraft.

The first-generation historians established the genealogy of modern architecture. Written within the German tradition of art history, these histories shared a deterministic philosophy of history characterized by a linear evolutionary pattern and a uniting spirit of the age, the *Zeitgeist*. *Space, Time and Architecture* by the Swiss engineer and art historian Sigfried Giedion (1888-1965) exemplifies this discourse.[112] Based on his Charles Eliot Norton lectures at Harvard University, this book interpreted modernism as the architectural representation of a new space-time concept discovered in modern physics, and treated it as a newfound synthesis amidst the processes of modernization. Giedion found support for his argument in the visual resemblance of architecture and the other avant-gardes representing space and time, movement and simultaneity. Hence, marking the beginning of a "new tradition," modern architecture was the aesthetic expression of a new scientific worldview. Contrary to other historians, Giedion did not advance social reform but emphasized positive progress facilitated by modern technologies and mass production. Giedion's interpretation of modernity was what Heynen calls programmatic and pastoral, and his view of technological progress deterministic and uncomplicatedly positive.[113]

As the general secretary of *Congrès Internationaux d'Architecture Moderne* (CIAM) between 1928 and 1956, Giedion was one of the inventors of modern architecture. His interpretation synthesized ideas of several other modernists such as the moral appeal expressed by Adolf Loos and William Morris; the space-time concept in architecture formulated by Theo van Doesburg and El Lissitzky; the application of new materials and construction techniques advocated by Le Corbusier; the interdependency of urbanism and architecture, which was a central theme of CIAM; and the ideas of organic and functional architecture expressed by Lazlo Maholy-Nagy and the Bauhaus.[114] His interpretation also evolved along the modern movement in response to criticism.[115]

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[112] Giedion, who immigrated to the United States in 1938, published extensively and his most important histories are Giedion 1948; Giedion 1956 (1941); Giedion 1995 (1928). For biographical information see Sokratis 1993 (1989).

[113] Giedion 1956 (1941), passim.

[114] Heynen 1999, 38-43.

[115] Especially Bruno Zevi (1918-2000) criticized Giedion for emphasizing technical innovation and the fourth dimension, which caused him to overlook the Arts & Crafts movement, Art Nouveau, Expressionism, and organic architecture. Zevi was an Italian architect trained in the Architectural Association School in London and Harvard University. He lived in exile in the United States during the Fascist regime and was

As Giedion's interpretation of modern architecture evolved with the architecture it documented, so too his histories reflect the way modern architecture gradually distanced itself from the often destructive and revolutionary avant-gardes and moved toward an established architectural style with a clear constructive program. For instance, Giedion's concept of interpenetration (*Durchdringung)*, introduced in the *Building in France, Building in Steel, Building in Ferroconcrete*, was developed into his central space-time concept in *Space, Time and Architecture*. As Heynen points out, *Durchdringung* did not simply describe the architecture of iron, glass, and concrete, but implied social mobility, provocation and activism, emancipation, liberation, and change in society. In contrast, the space-time concept no longer referred to the sociopolitical purpose of architecture. Instead, it was the newfound synthesis, the "new tradition" of integration, unity and harmony. From *Building in France* to *Space, Time and Architecture* Giedion's views then moved away from the avant-garde transitory concept of modernity toward a programmatic and harmonizing vision of modernity.[116]

Following Tafuri's critical argumentation,[117] Tournikiotis calls the first-generation discourse operative because of its ideological function and deterministic view of history. But as the establishment of modern architecture made the programmatic discourse unnecessary, so the perspective offered by a few decades enabled a more neutral examination of modernism. The second generation of historians emphasized the hitherto overlooked Arts and Crafts Movement, Deutscher Werkbund, the Futurists, and the Expressionists. Their questioning discourse reflected the influence of Rudolf Wittkower and Erwin Panofsky, who were likewise reinterpreting Wölfflinian art history.[118] The historians' approach also found parallel in the practice of postwar architects like Eero Saarinen, in whose opinion: "the second generation can… reexamine and question the actions and principles of its predecessors… our period must be regarded as a period of exploration and experiment."[119]

Theory and Design in the First Machine Age by the British art historian Reyner Banham (1922-1988) exemplifies this questioning discourse.[120] In it Banham revaluated

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highly influential in rooting American ideas in Italy during the Cold War. In 1960 he founded the Instituto di Storia dell'Architettura in Venice. See Zevi 1978; Zevi 1983 (1949), 126-134.

[116] *Giedion 1956 (1941); Giedion 1995 (1928); Heynen 1999, 38-43.*

[117] *Tafuri's criticism also applies to the second-generation historians like Banham, who was interrogating the program of modern architecture to advocate a scientifically progressive modern architecture. Tafuri 1979 (1968), 141-170.*

[118] *Tournikiotis 1999, 14-15.*

[119] *Saarinen, Eero, 1960. Problems Facing Architecture. The Benjamin Franklin Lecture Series, University of Pennsylvania, December 8, 1960. Unpublished speech, 3, 5. Writings, General Writings, box 28, folder 114. Series II. Professional Papers. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library*

[120] *Banham studied under Pevsner at the Courtauld Institute and worked as professor in the United Kingdom and the United States. He published several books on modern architecture including Banham 1966; 1969; 1975 (1962); 1976; 1980 (1960). As a member of the Independent Group and editor of the*

the work of his mentor Nikolaus Pevsner and discovered a "zone of silence" in the history of the modern movement.[121] His analytical reading of the modernist texts –especially those by the Futurists and Le Corbusier –revealed new layers of influences and interrelations, discovered inconsistencies in the ideas of Le Corbusier, and emphasized the work of the Futurists and Buckminster Fuller as the true expression of what he called the "First Machine Age" (with capital letters).[122] In Banham's view modern architecture –seen as the aesthetic equivalent of contemporary machines such as the automobile, the airplane, and the ocean liner –had actually failed to express the "First Machine Age." It relied on a theory of types, which as a system of perfected universal shapes could not relate to the constantly evolving technologies. Once the structure of machines developed into a shell construction concealing the motor, the presumed correspondence between architecture and technology was lost. Hence, to express what he called the "Second Machine Age," Banham proposed that architecture would evolve along –but be subordinate to –scientific and technological innovation.[123]

Banham's thoughts on the relation of technology and architecture, and his idea of the "Machine Age" make him a central historian in my study. Even though it is often claimed so, Banham was actually not a mechanical/aeronautical engineer, but he had worked for the Bristol Aeroplane Company during the war. His interest in engineering enabled him to notice parallels and incompatibilities between technology and visual culture –and permeated his interpretation with an overly optimistic view of technological progress. In this sense Banham not only continued the discourse initiated by Giedion's belief that modern architecture was based on science, engineering and technological advances, but also took it to another level of scientific progressivism. Hence, his views on technology were no less deterministic than Giedion's, although his interpretation of modernity was more dynamic and transient.

The work of the Italian architect and historian Manfredo Tafuri (1935-1994) represents another kind of questioning discourse.[124] Tafuri's early work had a distinctly cultural Marxist approach. In *Theories and History of Architecture* he interrogated history in order to demystify the narrative of modern architecture, and expose structures of production (the base) underlying architecture understood as ideology (the superstructure). He especially

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Architectural Review *between 1952 and 1964, he advanced Pop Art, Brutalism and Megastructuralism. See also Banham 1996. For biographical information see Whiteley 2002; Mattson 2004.*

[121] *On the zone of silence see Vidler 2008, 122; Whiteley 2002, 9.*

[122] *Alan Colquhoun has contested Banham's views and instead claimed that Futurism was not as opposed to Le Corbusier's academism as Banham claimed. Neither was Fuller's approach to technology any less idealist or aesthetic than Le Corbusier's. Banham 1980 (1960), passim; Colquhoun 1993 (1962).*

[123] *Banham 1980 (1960), passim.*

[124] *Tafuri was professor at the Instituto Universitario di Architettura di Venezia and founded the Instituto di Storia dell'Architettura. In addition to histories of modern architecture Tafuri published several studies on the Renaissance. The understanding of Tafuri's historical project has suffered from his labyrinthine style of writing and the erratic and non-chronological translation of his work. For biographical information and the cultural context of his work see* Casabella *619-620 (January-February 1995); Hoekstra 2005.*

criticized the historians of the modern movement for operative criticism. By this he meant selective history writing that aimed to construct the future, and distorted historical facts, in order to fit them into a priori pattern of development. Hence, operative criticism produced ideology.[125] In *Architecture and Utopia: Design and Capitalist Development* (1976) Tafuri argued that modern architecture could not be isolated from the economic infrastructure of capitalism within which it had developed and, therefore, there wasn't any real possibility of a critical architectural counter project.[126] This questioning of the socioeconomic foundation of modern architecture, and the lack of models for the architecture of the future, differentiated Tafuri's discourse from Banham's. Tafuri's concept of modernity was then what Heynen calls transitory and counterpastoral. However, Tafuri did not have a clear view on technology and rather seemed to avoid the question.

Tafuri's later book *The Sphere and the Labyrinth* was influenced by poststructuralist theory. In it he adapted what Carla Keyvanian calls "architectural" microhistory, a philological inquiry into literary texts, models, drawings, built works and their interrelations.[127] In Tafuri's view reality consisted of fragments and a plurality of languages, which in architecture included those of design, technologies, institutions, and history. Following Carlo Ginzburg, Tafuri viewed history as a jigsaw puzzle, in which historical fragments produced various combinations based on the criteria of selection. As a historian's construct and interpretation, history could then never possess absolute validity.[128] The political dimension in Tafuri's work notwithstanding, it is, in my opinion, exactly this jigsaw puzzle quality of history that should now enable the writing of history so that the airport terminal, which always had its place in the narrative of modern architecture, could be acknowledged.

Henry-Russell Hitchcock (1903-1987) –an American historian trained at Harvard –is the only historian, whose discourse could (according to Tournikiotis) be defined as objective or neutral.[129] However, one could also claim that such an approach was possible once the genealogy of modern architecture had been established and, therefore, other histories written in the sixties and seventies could also be described as neutral. Furthermore, Hitchcock's early histories such as *The International Style* were rather programmatic than neutral. *Architecture: Nineteenth and Twentieth Centuries* nevertheless represents positivist history writing, which is evident in the objective relationship it assumes between the historian and his material, evidence and the system of classification.[130] Hitchcock also revised his earlier programmatic discourse and criticized the utilization of International Style as a priori rules for modern academicism. Instead, he

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[125] *Tafuri 1979 (1968), xvi, 141, 151.*

[126] *Tafuri 1976; Tafuri 1979 (1968).*

[127] *Keyvanian 2000, 8-15.*

[128] *Tafuri 1987 (1980), 1-21. See also Ockman 1985, 182-189.*

[129] *Hitchcock published several histories such as Hitchcock & Johnson 1995 (1932); Hitchcock 1993 (1929); Hitchcock 1987 (1958). Tournikiotis 1999, 14-15, 113-116.*

[130] *Hitchcock also acknowledged that a neutral description of contemporary architecture was not uncomplicated. Hitchcock 1987 (1958), 513.*

argued that modern architecture had by the 1950s developed into contemporary style elastic enough to allow individual interpretation and diversity.[131]

In Hitchcock's view modern architecture synthesized abstract experimentation and historicism. This synthesis was achieved when aesthetic experimentation was integrated with modern engineering technology. Hitchcock's interpretation of modernity was thus programmatic and pastoral, and his view of technology deterministic. He emphasized the placement of modern architecture in the historical evolution of styles and used the concepts of style (slow evolution of architecture over centuries), style phase (defined by distinct aesthetic and historical elements within style) and mannerism (stylistically diversified margins between style phases) to construct a system of classification. Precursors, founders and followers were classified in relation to the dominant style phase. However, overlaying stylistic periods formed the dialectics of history and therefore the most important architecture was not necessarily the dominant one. Distortions in history writing happened when, for instance, historians emphasizing innovation overlooked historicism.[132]

Such a distortion is evident in the manner the airport terminal was overlooked by historians emphasizing other building types that supported their claims for "a new tradition," "modern architecture" or "the machine age." They concentrated on typically "modern" building types such as public housing, modern factories and hospitals. Consequently, it was not so much that the airport terminal was neglected in these histories, but that other building types (and especially the modern villa) were overemphasized. Giedion, for instance, also noticed market halls, green houses, libraries, department stores, railway stations and skyscrapers as building types, where steel structures, large planes of glass, and undecorated surfaces were utilized to express a new relationship between the interior and the exterior space. Thus, these "new" building types were noticed as precursors of modern architecture. However, adding the airport into this list of modern building types is not the aim of this study. Rather, I am writing a historical narrative that merits serious attention to a historical phenomenon that was previously overlooked.

Certain phenomena –and especially historicism and vernacular architecture –were excluded from the histories in order to construct modernism as a cohesive entity. Exclusion was needed to legitimize modernism,[133] and this process was not of minor consequence for airport architecture. In the writing of the canon historians evaluated architects as predecessors, pioneers, masters and conservatives while the actual date of the building mattered less than its position within the evolution of style.[134] Once the canon and its formation were questioned in a process, which begun in the 1950s with the second-generation modern architects like Ernesto Rogers, Philip Johnson and historians such as

[131] Hitchcock 1951, 89-97.

[132] Hitchcock 1993 (1929), especially xxi-xxiii, 218-219; Hitchcock 1987 (1958), 420, 530-554; Tournikiotis 1999, 124-126.

[133] Belting 2003, 26-27, 137; Nikula 2000, 231-232; Saarikangas 2002, 14-15.

[134] Belting 2003, 138-139.

Banham and Tafuri, the ideologies contained within the canon were exposed, historians' work revealed as projects, and a more comprehensive historical narrative revised.[135]

What seems to be a common denominator in these histories (with the exception of Tafuri) is the interpretation of modern architecture as a new synthesis that integrated progressive building technology with innovative aesthetics after a period of disintegration or rupture (be it reason/feeling for Giedion, abstract experimentation/historicism for Hitchcock, or futurism/academism for Banham). Architectural modernisms aimed to interpret the condition of modernity within the ongoing processes of modernization. Historians may have emphasized different architects, buildings, schools, and trends within the modern movement, but most of them nurtured a deterministic view of technology inherent in their fascination with the new construction techniques and a belief in constant positive progress. The coexistence of different discourses notwithstanding, modernism developed from an interwar programmatic discourse to a postwar questioning one. The second-generation historians dismantled the modern movement as it had been constructed in the earlier histories and not only revised the genealogy, vocabulary and canon of modern architecture, but also substantially questioned the methodology of writing architectural history. This questioning then resulted in a plurality of discourses present in postwar architecture culture and found its counterpart in architectural practices.

2.1.2. The Postwar Moment in Architecture Culture

The architecture culture of the postwar era witnessed a diversity of modernist discourses and movements. The revelation of the genocide and the advent of atomic warfare, together with postwar socio-political and technological changes, caused a profound crisis in rationalist thought and forced architecture culture into a process of self-questioning and reorienting. The idea of progress and technical advancement inherent in functionalism could no longer be uncritically maintained. Instead, architects aimed to integrate functionalism with more humanistic concerns such as social and psychological subject matter, symbolic representation, aesthetic expressiveness, and the antimodernist themes of monumentality, the picturesque, popular culture and regional traditions. At the same time accelerated modernization with the associated effects of demographic and territorial shifts, suburbanization, globalization of information and communication, and the expanding networks of transport provoked cultural criticism in the form of advocacy architecture, and a newfound interest in avant-garde. At the end of the postwar era the revision of modernism resulted in a major paradigm shift to postmodernism.[136]

According to Joan Ockman postwar architecture culture was dominated by normative International Style architecture and countered by various, questioning practices. In her opinion, International Style was apolitical and conformist. It aestheticized the ideals of rational planning and technological advancement, which were seen as the prerequisite for productivity and postwar prosperity. This explains why International Style was the chosen

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[135] *Howard 2002, 351.*

[136] Architecture Culture 1943-1968, *1993; Ockman 1993, 13-24.*

modernist idiom of corporate architecture. But in the Cold War climate International Style was also utilized as an American export and therefore modernists, such as Eero Saarinen, were employed to design embassies[137]. Yet International Style was not only conformist: it was also expressing the anxious individual experience of alienation, and lack of personal agency, in the highly technological and bureaucratized mass society facing nuclear disaster. In Ockman's view this was one of the main contradictions inherent in postwar architecture culture.[138]

While postmodernism falls outside the timeframe of this study, this paradigm shift cannot be overlooked as it influenced the interpretation of postwar architecture culture as late modernism or proto-postmodernism. These interpretations often find support in the oeuvre of architects like Eero Saarinen, whose work represented more than one of the postwar architecture currents and was thus labeled eclectic. While most postwar practitioners –including Eero Saarinen[139] –still aimed for synthesis and reintegration, an array of critical architecture was also emerging in projects as diverse as the paper architecture of Archigram and Superstudio; advocacy architecture; new discourse of autonomous architecture developed in the thinking of Aldo Rossi and the New York Five; and books like Bernard Rudofsky's *Architecture without Architects* (1964), Jane Jacobs' *Death and Life of Great American Cities* (1961), and Robert Venturi's *Complexity and Contradiction in Architecture* (1966).[140] It is then hardly surprising that Hitchcock defined postwar modernism as a late stylistic phase of modernism.[141] On the other hand, in Banham's view mature modernism was more diverse since, by definition, architecture had to respond to its own time and therefore could not maintain a single coherent style.[142]

Was postwar architecture then distancing itself from codified International Style and moving toward postmodernism? Rather, I would claim that the heterogeneity of postwar practices reflected the plurality of modernist discourses. As Hilde Heynen has argued,

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[137] *Eero Saarinen built the embassies in London and Oslo, albeit these buildings were controversial and their architectural vocabulary did not confirm with the modernist idiom. Loeffler 1990, 251-78; Tuomi 2006.*

[138] *Ockman 1997, 123, 128-129.*

[139] *Saarinen's efforts to analyze and expand the principles of modern architecture are discussed in chapter 5. See for instance Saarinen 1953a.*

[140] *New York Five refers to the "white" modernist architecture of Peter Eisenman, Michael Graves, Charles Gwathmey, John Hejduk and Richard Meier, whose work was exhibited in the Museum of Modern Art in 1967. It provoked a counter reaction of the "Grays" Romaldo Giurgola, Allan Greenberg, Charles Moore, Jaquelin T. Robertson, and Robert A. M. Stern, who emphasized vernacular architecture and whose work was symptomatic of early postmodernism. Venturi and Denise Scott Brown later published an influential book called* Learning from Las Vegas *(1972), which made even the vernacular of the "main street almost alright." In it they made a semiotic distinction between the duck (building as symbol) and the decorated shed (building as structure to which symbols and signage is attached) and claimed that most modern architecture represented the former approach since the expressive aim was distorted beyond the limits of economy and convenience forcing the building itself to become decoration. Jacobs 1961; Ockman 1997, 143-144; Rudofsky 1964; Scott 2007; Venturi & Scott Brown 1977 (1972).*

[141] *Hitchcock 1987 (1958), 580-582.*

[142] *Banham 1975 (1962), 5-6, 12-13.*

even the debate between modernism and postmodernism could be seen as a creation of radical opposition between insights and tendencies that were always present within the modernist discourses.[143] Hence, the postmodern condition did not replace modernity, but rather emphasized different meanings and paradoxical aspects of modernity.

Postmodernism could then be defined as a continuation of modernism, albeit in a different and more contradictory form, or as a counter reaction to orthodox modernism still functioning within the modernist framework. It questioned the foundation of the modern project in the Enlightenment and its faith in modernization, technological progress, rational thought and objective scientific truth. Instead, postmodernist discourse emphasized the subjective nature of truth, which led to plurality, relativism and a fragmented view of reality. It criticized modernism for a lack of historicity, and inability for renewal or self-criticism. Nevertheless, as Alan Colquhoun reminds us, modernism (like any architectural style) was always linked to history through continuities, disruptions, contradictions and similarities with historical buildings, projects and movements.[144] In fact, Anthony Vidler argues that modernism's relation to history was even more direct and active than that of postmodernism, which he calls *posthistoire.* In Vidler's view postmodernism reached a point where there was no possibility for further development and, therefore, it marked the end of not only modernity but also history.[145]

Dating of the postmodernist paradigm shift is not uncomplicated. Despite several tendencies having emerged already in the fifties, the philosophical paradigm shift to postmodernism happened only at the end of the seventies when poststructuralism and the work of Roland Barthes, Jean Baudrillard, Jacques Derrida, Michel Foucault and Jean-Francois Lyotard initiated a new discourse.[146] By the mid-1980s, postmodernism was established as a well-defined discursive formation.[147] But in architecture, postmodernism was already initiated with the publication of Robert Venturi's *Complexity and Contradiction in Architecture* (1966) and Aldo Rossi's *The Architecture of the City* (1966). Venturi, who worked for Eero Saarinen in he beginning of his career, advocated what he called both-and architecture and juxtaposed eclectic visual examples to demonstrate how the difficult unity of inclusion was a more accurate expression of the ambiguous modern experience. Rossi, on the other hand, approached the city as a human artifact, a repository of collective memory, and studied urban typology and architectural morphology.[148] As Charles Jencks summarized it in *The Language of Postmodern Architecture* (1977), postmodernism treated architecture as language, and embraced historic styles, including modernism, as a library of forms and types. It aimed for the multivalent architecture of pluralistic language, contradiction and paradox, complexity of meaning, reference, metaphors and irony.[149] Hence, it is easy to see how postmodernists

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[143] *Heynen 1999, 11-13.*

[144] *Colquhoun 1989 (1983), 8-37, especially 28-32; Nikula 1991, 6-11; Tournikiotis 1999, 240-243.*

[145] *Vidler 2008, 192-197.*

[146] *Berman 1988 (1982), 9-10; Lyotard 1984 (1979), 31, 37, 41.*

[147] *Martin 2010, xii.*

[148] *Venturi 1966; Rossi 1982 (1966).*

[149] *Jencks 1977.*

found precedents for their aims in the heterogeneous oeuvre of Saarinen although, in my opinion, it would be incorrect to call Saarinen's architecture proto-postmodern. Rather, placing Saarinen's work within postwar architecture culture makes framings such as modern or proto-postmodern obsolete.

Modernism was not a coherent architectural movement with a singular discourse or concept of modernity. Rather, it contained a variety of modernist practices that took different shapes over a timeframe of four decades. How should one then study the plurality of these architectural mediations of modernity? Anthony Vidler proposes an approach that refuses closure and maintains the questions posed by modernity still open for debate. He suggests reassessing disruptive moments in the history of modern architecture as openings into the processes of modernity, and revaluating the canonical figures, objects and historians of modernism in order to detect internal inconsistencies and open questions. The work of historians like Banham and Tafuri, who attempted to construe modernity according to their particular vision of the future in the past, could then be seen as instances of modernity's self-reflection, and even postmodernism would find its momentary and recurring place in the continuum of modernism.[150]

Eero Saarinen and his airport terminals constitute this kind of disruptive moments that perform as openings into the definitions given to modernity and technology in the discourses of modernism. Revaluating Saarinen's terminal buildings and their placement in the canon reveals inconsistencies in the formation of the canon and the historiography of modern architecture. On one side Saarinen's architecture was heroic resistance to "high modernism" as most clients would have preferred the International Style glass box. On the other hand he was not only obedient to commercial architecture but negotiated its parameters in his controversial oeuvre. Hence, his architecture was a commentary on modernism; it was broadening the vocabularies of modern architecture. Furthermore, and perhaps even more importantly, the airport terminal maintains the question of technology's role in modern architecture open for debate.

The procedure of reading the disruptive moments permits the claim that many relatively autonomous but reciprocally linked subcultures were present in postwar architecture culture. Even when International Style modernism was the dominant architecture characterized by its aesthetic codes and parameters for practice, it was counterbalanced by a wide array of subordinate architecture cultures and practices, alternative design strategies and interpretations of modernity. In fact, as Carlo Ginzburg claims, culture, which as a concept is borrowed from cultural anthropology, does not even refer to the dominant culture but rather to the complex of attitudes, beliefs, and codes of behavior of the subordinate cultures. Dominant and subordinate levels of culture are thus intermingled through reciprocal movement of influences even when the exact nature of their relationship remains somewhat controversial.[151] This is exactly the case of postwar architecture culture, a specific moment when International Style as the dominant architectural style was challenged by other interpretations of modernity.

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[150] *Vidler 2008, 199-200.*

[151] *Ginzburg 1980 (1976), xiv-xxvi.*

In the case of the airport terminal it is important to specify the particular type of modernity it represents and localize the processes of modernization incremental to its emergence. The modernization of any form of transportation is necessarily conditioned by the specific geography and infrastructure of its location. Modernizing postwar aviation infrastructure in Greece differed significantly from the same process in postwar United States. At the same time mobility was increasing on a global scale when aviation became a form of mass transportation. The airport terminal is positioned in a lineage of buildings – such as the gas station, the railway station, and the parking garage –constructed specifically for transportation. It stands as the node in the networks of highways, railways and airways forming the infrastructure of transportation. However, its modernity is that of transience, speed, and movement, which did not coincide with the programmatic view of modernity dominating the discourses of architectural modernism. Rather, the airport terminal was positioned outside the narrative of modern architecture as its blind spot. It thus formed the antithesis of modern architecture.

2.2. The Question of Technology

One question that remains open in the debates about modernity is technology's relationship to modern architecture. In the case of a building type as closely linked to a particular technology as the airport terminal, it is intriguing to view the evolution of technology in relation to the development of modern architecture. This is especially so when it is often claimed that the airport followed the development of the aircraft, the machine it was designed to serve.[152] However, while it is indisputable that the aircraft and its technical specifics (for instance size, weight, capacity and related spatial requirements for mechanical services, runways, passenger and luggage handling) shaped the airport terminal and its functional lay-out, it is highly questionable whether the building type actually followed the evolution of aviation technology. There were other constituent facts in its formation, because the airport is not just infrastructure but architecture. To clarify the question it is then important to define technology, and more specifically the aircraft, as a technological object.

Technology is a term that came into common use only after the Second World War, when several wartime technologies were adopted into civil use. The historian of technological systems Thomas P. Hughes defines it as craftsmen, mechanics, inventors, engineers, designers, and scientists using tools, machines, and knowledge to create and control a human-built world consisting of artifacts and systems associated mostly with the traditional fields of civil, mechanical, electrical, mining, materials and chemical engineering, but expanding also into aeronautical, industrial, computer, environmental engineering and bioengineering. Additionally, technology is an important source of symbols in modern culture and architecture, which is evident when the historiography of

[152] *Banham 1962b, 252-253. However, this idea is repeated in most histories of aviation and studies of the airport.*

modern architecture is read in relation to technology.[153] Hence, technological objects, such as the aircraft are defined as heterogeneous artifacts that have their materiality, structure, and performance, but also social, political, economic, psychological and historic qualities.[154]

Furthermore, as sociologist of technology Donald MacKenzie argues, technologies are not just artifacts and human activities but also knowledge, if knowledge is defined as shared institutionalized beliefs about machines and their relation to society. Thus, the definition and usefulness of a technological object depends on knowledge about its characteristics and the ability to use it. If we accept that technology is knowledge producing hard facts similar to scientific facts, technologies may be challenged since knowledge claims do not possess absolute warrants from logic, experiment or practice. Technological facts are rather conditioned by the interests, traditions and experience of social groups involved, and the relative credibility and prestige of links in the networks of knowledge. Hence, technological knowledge is not universal, independent of context, impersonal, and cumulative, but local, situated, person-specific, private, and also tacit, noncumulative knowledge. Its universality is a result of laborious and costly construction of networks that link heterogeneous entities.[155]

According to another scholar of Science and Technology Studies, Edward W. Constant, technological knowledge is not only embodied in the tactile artifacts, but also in communities of technological practitioners defined by tradition, not discipline. For instance, in the case of the turbojet practitioner, the discipline ranges from aerodynamics to mechanical engineering, combustion engineering and metallurgy, and a specialist might be an individual or a complex organization. While technology defined as knowledge is embedded in these communities of practitioners, technology understood as function is socially mediated by complex organizations. Together these communities and organizations create technological culture, which sustains technological systems with their normative values and traditions of testability. Technological organizations, communities and systems are then intertwined in a manner that a radical change in the technological artifact, such as a shift from air compressors to turbo air compressors, might necessitate changes in technological culture and alter the community of practitioners.[156]

Technological objects are often viewed as closed objects, "black boxes" that refer only to themselves since their history and functionality are believed to be beyond accurate description, dispute or critical study. This concept, which originated in cybernetics when the complexity of machines and set of commands developed beyond accurate description, is often used to describe technical artifacts or processes that perform their function without the users having awareness of their internal workings. In addition, and particular to aviation terminology, a black box is a navigation system that records information and operates independent of any input from the outside world.[157]

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[153] *Hughes 2004, 2-5.*

[154] *Bijker & Law 1992, 8-10.*

[155] *MacKenzie 1990, 10-11; MacKenzie 1996a, 9; MacKenzie & Spinardi 1996, 215.*

[156] *Constant 1987, 224-228.*

[157] *MacKenzie 1990, 26; Latour 1987, 2-3.*

Inability to open these black boxes nourishes the idea of technological evolution. Even though the deterministic view of technology (according to which technical change is autonomous; independent of any political, economic or social concerns; and in fact the major cause of social change) has been dismantled, a belief in the natural trajectory of technological change still prevails. The idea that technological development is driven by its nonsocial and internal dynamic resists criticism. Often a study of an existing, mature technology along the path of its development seems to reveal this kind of a natural trajectory from initial innovation through the prototype to the final product, but the idea of linear progress does not correspond to the detailed history of technology. In reality, chaos of ideas, prototypes and projects seldom forms an orderly pattern of development.[158]

If a technology such as the aircraft is viewed before it became an undisputed object, networks shaping its development, controversies, and even other alternative albeit mostly unsuccessful technologies become visible. Several actors are involved in the process shaping the technology. Most obviously professional groups and institutions such as scientists and engineers, competing laboratories, politicians, ministries and other public funding institutions are major actors, but government policies, subtle layers of political and social and economic interests, organizational structures, scientific facts, research processes, and the material and phenomenon studied (for instance aerodynamics) are decisive factors in developing a particular technology that, if successful, becomes a black box, the only existing alternative. Hence, following the production of a particular technology reveals how resources are channeled into competing projects and how a gradual cumulative process of technological change becomes institutionalized. This process may then look like a natural trajectory although it is thoroughly constructed.

The assumed intrinsic superiority then hardly explains the success of a particular technology. Instead several factors contribute to its success. One such factor is that beliefs and expectations about technologies are often self-fulfilling and actively create the conditions to which they refer. Belief in future success of a technology guides research effort, attracts investment, and encourages adoption, which in turn accumulates experience of its use and leads to further research, investment, and improvement. In this manner evidence accumulated through the development process reinforces the original belief. But while adoption leads to the improvement of one particular technology, other similarly capable technological alternatives are simultaneously stagnating as beliefs about their future become self-negating rather than self-fulfilling. Even after a normative, successful technology has been established, alternative technologies may continue to be developed but will eventually vanish and become invisible due to diminishing funding and scarce resources.[159] Many such examples of both successes and failures are visible in the history of aviation, most notably the failure of the Tactical Strike and Reconnaissance aircraft TSR.2, and the success and ultimate failure of the Concorde.[160]

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[158] *MacKenzie 1996a, 5-6.*

[159] *MacKenzie 1996a, 7.*

[160] *The Anglo-French Concorde was a magnificent high technology feat, but a commercial failure due to severe flaws in planning. Concorde's product marketing was insufficient, national airlines were not involved in the planning, and the military supervision of the project led to a lack of commercial evaluation.*

In this sense the production and use of technologies is thoroughly social, economic and political. On hindsight a successful technology usually looks like the most efficient and best alternative, but as MacKenzie points out, we should always ask, best for whom? Technology has various meanings for different social groups, whose interests, views and needs shape it. After the criteria for the best technology is negotiated, discrepant meanings and views are usually dismissed as irrational resistance to natural technological change. Obviously then the technology that succeeds is not always the best. Nor do all good technologies necessary become successful.[161]

Rather than having a momentum of its own, technology is a product of contingency. New technologies are most often generated out of dispute, disagreement and resistance, and their development is shaped by the strategies of those involved. Hence, technologies are stabilized only if these heterogeneous relations are stabilized. It then follows that technology is an emergent phenomenon that has attributes not possessed by any of its individual components. Actors involved do not simply construct a technological artifact, but are reconstituted in the networks formulated through the process of construction. In the writing of history, one should therefore be aware of the persistent forms of technological determinism, any form of technological trajectories and design paradigms, and question the intrinsic superiority of particular technologies, identify alternative paths of their development, and reveal the network involved in their construction.[162] In this study I extend this approach to modern architecture that claims to have aestheticized the visual language of science and technology.

2.2.1. The Machine Age and Other Techno-Deterministic Tendencies

If the natural trajectory of the aircraft's technological evolution does not exist, then surely a building type cannot follow a predetermined development pattern either. Similarly

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Furthermore, the agreement between the governments did not allow withdrawal or cancellation, which meant that the project was guided by a political treaty tied to electoral consequences, and concerns about national image and high technology capability. Lack of airline involvement, unlimited funds, prestige, and the challenge to work with a new technology caused three major cost increases following major redesigns in 1963, 1965 and 1967. The Concorde entered service in 1976 and caused severe losses to the British Airways and Air France, which were covered by government subsidies. By 1978 $4.28 billion had been used to build two prototypes and fourteen commercial planes. The plane cost $267 million but was sold for the purchase price of $80 million to even remotely justify the project. The Concorde's range, limited to 3650 statute miles fully loaded (with only 112 seats), cut down the number of potential routes and users. Its supersonic properties could not be used over populated areas and therefore the aircraft flew coast to coast or over desert, and access to cities, which were identified as perfect commercial routes, were hard to gain. Concorde had a fatal crash in Paris in 2000 and ceased to fly in 2003. Feldman 1985, 89-127; TSR.2 was a military aircraft project that failed because of poor planning. It is discussed in more detail in chapter 5.1. Law & Callon 1992, 21-47.

[161] *MacKenzie 1996a, 6.*

[162] *Bijker & Law 1992, 8-10; Hughes 1987, 51-81.*

alternatives to its typological development must exist, and its construction be shaped by a network, in which the aircraft is but one of the *actants,* to use the term that Bruno Latour has developed to include not only the human but also the non-human actors influencing technological development.[163] It then follows that the aircraft is a hybrid,[164] a natural, cultural and social construction consisting of natural phenomena, engineering skills, innovation, materials stretched to their ultimate performance, myths and beliefs associated with flight, funding and politics to mention but a few of the factors active in its construction.[165] While the airport terminal does not simply follow the evolution of the aircraft, it does provide infrastructure for aviation. It needs to accommodate the machine it is designed to serve and therefore the advancements in the aircraft's design are of importance to architecture. But there are other concerns including but not limited to individual artistic aims of the architect; the client's desires that are not solely for a cost-efficient airport terminal but also for a stunning architectural structure and innovative design; organizational structures of both the architectural office and the client; government bodies and regulations; engineering techniques, structures and building materials; and all the professionals involved in the construction industry. Furthermore, architecture has its theory and culture, tradition and history that shape the formation of any building type.

It is important to realize that the process shaping the construction of an architectural artifact is often concealed. Not only the construction process but also the historiography should then be opened for questions, since historical accounts are never neutral but work to influence history and generate the conditions for their own validity. In this sense the aircraft, the typology of the airport terminal, and the historiography of modern architecture are black boxes in need of investigation. Furthermore, the airport is not just an architectural object but also a substantially large technological system. In order to understand the airport terminal we need to understand technology and its complex, historical relationship to architecture.

If there is a parallel between architecture and technology, it is not one of modern architecture being a logical result of technological progress, but of architecture and technology being similar cultural constructions. In fact, technology and architecture are rooted in the same socio-economic ground that determines them and informs their mutual relations.[166] To a large extent the critique of technological change applies to architecture. Hence, buildings are not merely architectural objects but institutionalized knowledge about architecture and its relation to society. Furthermore, architectural development is not autonomous, driven by its nonsocial and internal dynamic, but rather a process of conflicts and contradictions that only rarely form an orderly pattern. Yet, a "natural" trajectory of architectural development has found its most explicit expression in the histories of modern architecture. The beliefs about the foundation, characteristics and future of modern architecture embedded in the historiography functioned as a self-fulfilling prophecy leading to the adoption and enforcement of modern architecture, while other, alternative

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[163] *Latour 1988 (1984), 159-160.*

[164] *Latour 1993 (1991), 10-11.*

[165] *See for instance Feldman 1985.*

[166] *Picon 2010a, 224.*

modern architectures stagnated and became increasingly invisible. Nevertheless, it is possible to recover (as I do in chapters three and four), these alternative trajectories when the narrative of modern architecture is questioned for its inconsistencies and exclusions.

Indeed, not unlike technology, architectural change is thoroughly social, economic and political and cannot be explained in isolation from these circumstances. Changes in architecture are related to changes in the preconditions of its use, the ways it is used, the users themselves, and the reasons for its use. Therefore it is imperative to ask whom architecture is designed for? What kind of a user does it imagine? As efficiency was often used to justify a particular design for an airport terminal and advance a certain typological development, one should ask, why a particular technical reason was found compelling, and how was efficiency defined? It is of importance to investigate the meaning and definitions of technology in architectural discourses as the history of modern architecture is also a black box of sorts that needs to be opened in order to understand its inner complexities and contradictions, concealed in the deceivingly complete narrative of its development.

The notion of technological evolution is embedded in the historiography of modern architecture, which draws a parallel between architecture, and the development of modern engineering, science and technology. In fact, as Antoine Picon argues, among the founding assumptions of modern architecture was the belief that modernism had a more direct relation with technology than its nineteenth-century counterpart.[167] For instance, in *Building in France* Giedion claimed that the evolution of modern architecture followed revolutionary inventions in progressive nineteenth-century engineering, and that new construction materials and engineering skills demanded a new kind of architectural vocabulary.[168] In *Space, Time and Architecture* he developed this idea further and interpreted the evolution of modern architecture as the materialization of technological and scientific advances. This interpretation found support in the rhetoric of architects and especially the writings of another inventor of modern architecture, Le Corbusier. His *Towards a New Architecture* (1923) celebrated automobiles, locomotives, ocean liners and aircraft as the modern machines and compared their development to that of architecture.[169] Interestingly the preoccupation with machinery led Giedion to publish *Mechanization Takes Command: A Contribution to Anonymous History* (1948), which is a seminal history of anonymous innovation, everyday utilitarian objects, and the effects of mechanization. In it he analyzed the process of mechanization in a variety of industries and technologies, including but not limited to histories of the assembly line, patent furniture, mechanized food production, and the reorganization of the kitchen and the bathroom. He showed how

[167] *This resulted in an excessively unified view of modernity, and a misconception of nineteenth-century architecture's approach to technology and engineering. Not only did nineteenth-century architects advance prefabrication and standardization, but the modernists' approach to technology was more diverse and ambiguous than believed. Their approach to technology was influenced by fetishism of technological artifacts and ambiance of places like factories and battlefields at least as much as a quest for rationalization. Picon 2008, 79-80.*

[168] *Giedion 1995 (1928).*

[169] *Le Corbusier 1986 (1923); Giedion 1956 (1941).*

the totalizing effect of mechanization had reorganized the environment and the way people lived and related to each other and nature. Hence, Giedion revealed mechanization as the end product of modernization and rationalization.[170]

Banham was the second historian of architecture to take an interest in the anonymous history of technology and its relation to architecture. In *The Age of Masters: A Personal View of Modern Architecture* (1962) he analyzed the impact of technologies such as lighting, ventilation, heating, air-conditioning, mechanically operated elevators, and electronic communication in architecture. *The Architecture of the Well-Tempered Environment* (1969) further discussed the evolution of modern architecture along technological innovations. Many of his articles also addressed various technologies. In 1960 Banham initiated a series of articles on design, science and technology for *The Architectural Review*. His opening essay "Stocktaking" discussed architectural tradition in relation to technological progress claiming that they were distinctly separate disciplines. He also anticipated that the emerging fetishism of the computer would lead to a disappointment similar to the one experienced by the first-generation modernists in relation to the machinery of the 1920s. Other articles in the series were commissioned from experts in engineering, weapons systems, computer science, and social sciences, and discussed the potential impact of modern science on architecture and design. In this manner Banham continued the technological discourse initiated by Giedion and expanded it to address not just modern physics and mathematics but also modern biology, weapons systems, and computer science.[171]

In fact, Banham is often seen as an advocate of technology. In *Theory and Design in the First Machine Age* he argued that the Second World War marked a shift from what he called the "first machine age" to the second one and even though these two eras were closer to each other than any other period in history before, they were substantially different. The "second machine age" could have also been called the jet age or the detergent decade, due to such novelties as jet travel, vacuum cleaners, refrigerators, computers and televisions, synthetic fabrics and washing detergents, plastics and aerosol shaving cream. This was a throwaway culture that could afford to spend on new consumer goods. Hence, telephones, radios and televisions invaded households and brought mass-communication into the center of the living room. Television as a transmitter of mass culture and popular entertainment was the most distinguishable object of the era. Unlike automobile, the symbolic machine of the "first machine age" available only to the elite, televisions and entertainment were readily available to everyone regardless of class. The change therefore was more qualitative than quantitative even when the number of consumer goods lured people to believe otherwise. It was this "second machine age" that postwar architecture was expected to materialize.

Banham's "machine ages" corresponded to the timeframe and definition of industrial revolutions. The first industrial revolution had extended human productivity beyond existing needs and relied on capital, technology, and the division of labor, while the

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[170] *Giedion 1948.*

[171] *Banham 1975 (1962), 58; Banham 1969. For articles see for instance Banham 1996 (1965), 109-118; Banham 1993 (1965), 371-378. Banham 1996 (1960), 49-63; Vidler 2008, 130-133.*

second entrusted intellectual processes to automatic machines and was characterized by cybernetics, atomic physics, and biochemistry.[172] In Banham's definition "machine ages" were determined by the relationship between man and "the machine," which symbolized the typical technologies of the day. The transfer from the first to the second "machine age" had political importance, because it changed the availability, control and symbolic value of "the machine." In the "first machine age" the elite, for whom the new machinery was economically most beneficial, never physically operated the machines of production. Nevertheless, they used machines such as the automobile in their leisure activities. In contrast, after the war it was fashionable to use a variety of small domestic devices. In the "second machine age" the machine expertise was no longer limited to working-class elite of engineers and technological experts. Instead, machinery became an instrument of social change and emancipation: it had potential to free people from physical labor and form new professional classes. This time, middle class professionals benefitted the most from the domestic revolution and electrical devices, leisure and mass entertainment industry.[173]

Banham's visions were in sharp contrast with the British postwar reality and applied more to the United States, which had inspired his social circle, the Independent Group of young architects, designers and artists interested in America, advertisement, fashion, popular culture, contemporary technology, and mass media.[174] Not only had the "machine age" approached the prosperous United States faster than Europe, but American consumer culture had also developed quicker than its European counterpart. Americans had such luxury domestic devices as washing machines and dishwashers even before the World War II and after the war all the electrical appliances Banham mentions were readily available. In Europe it would take several years, even until the completion of postwar reconstruction, before "second machine age" goods reached middle class homes.[175] Nevertheless, Banham's vision was something that people desired and it matched with the imagery produced in film industry, literature, art and advertisement. The changing attitude toward American culture is perhaps best followed in two issues of *Architectural Review*. While the first issue of December 1950 condemned the United States as a visual wasteland or the "mess that is manmade America," the later issue of May 1957 titled "Machine Made

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[172] *As Reinhart Koselleck reminds us, the inauguration and nature of these revolutions is still debated even when these terms are commonly used to refer to the processes of industrialization. Koselleck 2004 (1979), 43-44.*

[173] *Banham 1980 (1960), 9-12.*

[174] *Independent Group organized exhibitions, the most notable of which was "This is Tomorrow" exhibition at the Whitechapel Art Gallery in August 1956. The group included Reyner Banham, art critic Lawrence Alloway, architects Peter and Alison Smithson, Colin St. John Wilson, Geoffrey Holroyd, James Stirling, Sam Stevens and Peter Carter, and artists John McHale, Richard Hamilton, and Nigel Henderson among others.*

[175] *In Finland for instance, it was not until the 1960s that everyday domestic machines like refrigerators and washing machines became more common. Even cars in the 1950s were still luxury items. Hankonen 1994, 77, 89, 97; Pantzar 2000, 42.*

America" saw the future of architecture in the efficient, economical and good-looking modern architecture and identified the curtain wall as the new vernacular.[176]

In Banham's view machine enthusiasm that had launched the modern movement had also left it erratic, since modern architecture failed to aesthetically realize the potential inherent in technological advances. The symbolic language chosen by the modernists communicated only in the 1920s when aircraft structure actually resembled elementary space cages. But this resemblance was not a result of principles common to architecture and technology. Once performance and economics made it necessary to pack components into a compact and streamlined shell, technological devices took other forms such as those found in the Heinkel He 70 research aircraft or the Boeing 247D transport aircraft, and the visual resemblance was lost.

Similar changes did not happen in architecture, which instead perfected the modern style according to its own laws of construction and aesthetics. Neither did architecture resemble the stylist-designed automobile such as Harley Earle's Lasalle (1934), the aesthetics of which followed the needs of mass-production for a changing market rather than an unchangeable type or norm. Instead, modern architects thought technology would evolve into a final type achievable in the immediate future. Thus they failed to understand that technological progress would never halt in an ideal type unless research and mass-production was stopped. Consequently, the International Style in Banham's opinion ceased to be the architecture of the "machine age."[177]

In a later, revised introduction to the *Theory and Design in the First Machine Age* Banham was even more convinced that architecture and technology were substantially incompatible disciplines. While in the first edition of 1960 he had been confident that "second machine age" architecture would find the proper expression of its technological environment, in the second edition of 1980 he was doubtful whether the kind of scientific aestheticism he had promoted could possibly be achieved. The enthusiastic description of the "second machine age" was replaced with a new layer of questioning. Banham especially criticized the machine enthusiasm of the modernists and asked, if the creaking fabric-covered aircraft, cart-sprung automobiles or enormous and complex radios could have really offered the claimed effortless conquest of time and space? Yet, Banham closed his evaluation with the same phrase as in the first edition: "The cultural revolution that took place around 1912 has been superseded, but it has not been reversed." He thus maintained his belief in technological advancement. What was then left to do, was to acknowledge and understand the "ghosts in the machine," the romantic dreams and visions imprisoned in the inexpressive postwar glass towers.[178]

The seminal histories by Giedion and Banham outline architectural determinism similar to technological determinism. To be more precise, they outline architectural determinism that follows technological determinism. This evolution trajectory of modern architecture seems flawless when viewed from the distance, but it leaves a large number of

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[176] Architectural Review *(December 1950), especially 339, 414;* Architectural Review *(May 1957), especially 307.*

[177] *Banham 1980 (1960), 328-329.*

[178] *Banham 1980 (1960), 9-12.*

technological and architectural experiments and alternative practices in the shadows of the historical narrative. The trajectory exists only since the historians, architects and users of architecture fulfilled a promise drafted in the manifestoes and histories of modern architecture. In this sense, the history of modern architecture resembles a mythology with its noncontroversial beliefs, precursors, mythical founders and revolution countering the otherwise slow evolution of architecture.[179] This mythology then forms a framework within which the activities and practices of architecture culture, its complex mixture of beliefs, habits, systematized knowledge, exemplary achievements and experimental practice, tradition, and craft skills are situated.[180]

The annals of modern architecture are problematic because they are written as member's accounts and therefore do not question the presuppositions of contemporary cultural practice. As Steven Shapin and Simon Schaffer emphasize in relation to the history of science, it would be important to "play the stranger," scrutinize these presuppositions, and know there are alternatives to accepted perceptions. One way to accomplish this is to study controversies when disagreement prevails over the reality of entities and the propriety of practices, which are later accepted as unproblematic and settled. In these occasions historical actors aim to deconstruct the opponent's beliefs and practices and work to write things out of history[181]. When successful, the standard historiographic strategy for handling such rejected knowledge is to exclude it from the historiography, establish it as an error, and provide it with a causal explanation.[182]

Similarly in the histories of modern architecture criteria for exemplary buildings was used to reject other buildings and styles as less valuable. These buildings were explained to be products of traditional practice that did not advance progressive architecture. However, paradoxically modern architects often utilized conservative construction techniques and concealed them under a white, even surface. Rationalism was then an aesthetic choice associated with modern construction techniques and materials, which would have allowed a variety of aesthetics and forms. It was the historical setting that made the modern aesthetics and architectural practices preferable over alternatives as they related to intellectual advancements in other areas of culture, and materialized forms of social organization. Solutions to the problem of architectural knowledge and form were in this sense embedded within practical solutions to the problem of social organization.[183] Hence, regarding architecture's relation to society, architecture is neither determined by social factors (albeit these influence architecture), nor does it neutrally serve an unchanging social order. Instead, construction involves changes, which are not automatic

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[179] *For a similar reading of science practice see Latour & Woolgar 1986 (1979), 54-55.*

[180] *Barthes 2000 (1957).*

[181] *Most studies of science and technology focus on controversies or situations when alternative development patterns were explicitly available like in Albena Yaneva's description of scale modeling or controversy studies of architectural disputes, but consensual science may also be studied the way MacKenzie studies insider uncertainty. Shapin & Schaffer 1985, 3-7; MacKenzie & Spinardi 1996, 215-258; Yaneva 2005, 867-894; Yaneva 2012.*

[182] *Shapin & Schaffer 1985, 11.*

[183] *Shapin & Schaffer 1985, 14-15.*

but engineered in a process stabilizing actors and social relations. In this sense society is constructed with architecture and technologies that make more complex societies possible, and therefore architecture, technology and society are not separate entities but intertwined.

In light of this discussion, it is intriguing to view postwar debates on modern architecture as a moment of disagreement when alternative practices were questioning the dominant one, and there was uncertainty about the direction of architectural development.[184] Architectural practices left outside the narrative of modern architecture are in need of a detailed analysis in order to understand the modern project through its strategies of exclusion and view the architecture of the twentieth century in its plurality. That is to say that the historiography of modern architecture is only defined in relation to what is excluded. This type of analysis, which has been applied to housing, is in this study extended to include the airport.[185] Furthermore, it is imperative to apply the same interpretative framework to buildings excluded from the canon of modern architecture as is applied to the architecture included in the histories in order to understand the voids the rejected buildings have created in the narrative of twentieth century architecture.

This idea of one interpretative framework is an extension of the symmetrical sociological analysis developed in the sociology of science to study the construction of knowledge. It argues that same type of explanation should be used for both true and false beliefs, and counteracts the tendency to explain true beliefs in terms of correspondence with reality or nature and false beliefs in terms of psychological or social factors. To counteract the asymmetry current evaluations of adequacy are rejected in favor of one interpretative framework. This approach has provided valuable information about the social processes involved in the construction of scientific knowledge, although the relativism of what David Bloor has called "the strong program of the sociology of knowledge" has since been disputed. While the symmetrical method is widely accepted its Actor Network Theory extension to include human and non-human *actants* alike has been a cause of a severe dispute. In the case of the historiography of modern architecture this method demonstrates how modern architecture is constructed in relation to what is excluded.[186]

Could modern architecture then be "uninvented"? Donald MacKenzie has argued that nuclear weapons could be uninvented, since they are a product of a complex process of

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[184] *An excellent example of such an approach to architectural history is Felicity Scott's study of architectural practices, where she maps an alternative genealogy of the postmodern turn in architecture. Scott 2007.*

[185] *Santala 2003; See also Saarikangas 2002.*

[186] *Harry Collins and Steven Yearley oppose the extension to* actants *proposed by Bruno Latour and Michel Callon claiming it leads to asymmetry regarding truth and falsehood, and privileges scientific behavior over other types of behavior. In response to this criticism a shift from relativism to realism has been proposed once what Latour has called techno-science (the interconnected network of science, technology, special processes and social interests) settles a dispute and nonhuman entities become acknowledged actors. Bloor 1991 (1976); Callon & Latour 1992, 343-368; Collins & Yarley 1992a, 301-326; Collins & Yearley 1992b, 369-389; Latour & Woolgar 1986, 23-24; Law 1987, 130; MacKenzie 1996a, 9-10, 14-16; Latour 1987, 100, on techno-science 174-175.*

negotiations rather than an inevitable consequence of technical change, and since scientific knowledge is not only cumulative explicit knowledge transferred in documents, but also tacit knowledge transferred locally between practitioners. This is evident when one considers the way nuclear weapons were to some extent reinvented (although explicit knowledge and black box technologies were available), when this technology was transferred to the Soviet Union, the United Kingdom and France. Therefore, if technologies are thought of as this sort of social institutions, it is possible to also imagine their disappearance.[187] Similarly, modern architecture is not an inevitable consequence of modernization or technical advances, but tacit knowledge transferred between practitioners in a network of architectural production. Revealing the processes shaping the formation of modern architecture suggests possibilities to intervene and uninvent modern architecture since architecture's conditions of possibility, like those of technology, are social.

But uninvention is impossible as long as the belief in the natural trajectory of technology is maintained. Even when architectural determinism has been dismantled, architecture nurtures a belief in technological determinism. The idea of evolving construction techniques and materials maintains the belief in new architectural forms made possible by new technologies and hence, architecture continues to evolve along imaginary technological trajectories. But technological trajectory is only a direction of development corresponding to the inherent possibilities of technology, and a certain trajectory is sustained only if social interest is created in its continuation. Therefore, it is not self-sustaining, but an institutionalized form of technological change related to particular social circumstances.[188]

As long as the belief in the natural trajectory of technology is held there is no real possibility of questioning the formation, generations, or the development trajectory of modern architecture. In fact, even the concept of generations sustains the belief in a development trajectory. Furthermore, uninvention is only a possibility or an experiment, as uninvention would immediately raise the question, what would replace it? Would it be one of the styles preceding it or maybe a "new tradition"? This would suggest anti-modernism or a truer modern architecture of the future not unlike the one proposed by the second-generation historians. Hence, while modern architecture could be theoretically uninvented its historicity cannot be erased. By now, modern architecture is a historical product, a phenomenon studied within the history of architecture. Rather, the experiment of uninvention, the process of interrogation evident in chapters three and four of this study, reveals a plurality of technological possibilities, alternative architectural development patterns, and various discourses that were present when modern architecture was invented. It clarifies how architects noticed, utilized and expressed technology in practice and reveals alternative ways to address technology in architecture. Furthermore, it highlights other building types such as the airport terminal that maintains a specific relation to progressive modern technology.

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[187] *MacKenzie 1990, 3-4; MacKenzie 1996a, 22; MacKenzie & Spinardi 1996, 215-258, especially 215-217.*

[188] *MacKenzie 1990, 167-169.*

2.2.2. The Airport as a Large Technological System

If the airport is seen as not just an architectural object but also as a substantially large technological system, it could be described as a node in the networks of architectural practices and discourses, technologies, air routes, and actors partaking in their production. Science and Technology Studies provide some useful methodological tools for the analysis of architecture as this kind of a system or network of actors, practices, discourses and their interrelations.

First, the airport may accurately be described as a feedback system, wherein the loops of feedback function to correct errors and perfect the system through repetition.[189] The loop-like and self-sustaining character of this kind of a strategy of coordination is visible in pictures depicting passenger, aircraft and mobile lounge circulation at the Dulles International Airport (fig. 2.1).[190] This loop begins with the landing and ends with the takeoff; moves through taxiing and standby on the apron; deplaning of passengers into mobile lounges that transport them to the terminal building for immigration, luggage claim and ground transportation. The loop then seamlessly transfers into the circulation of passengers from ground transportation through the terminal building, check-in, concessions, passport and security controls, mobile lounge transport and enplaning, while the aircraft is maintained at the apron and filled with fuel, food and luggage, prepared for the flight, and taxied to the right position for takeoff.

These circulation routes are not one but many: the landing, unloading, loading, maintenance and takeoff of the aircraft and the separate circulation routes of the passengers, luggage and other goods through the terminal building and apron. According to the FAA standards, the circulation area of the aircraft is defined as the approach zones, runways, taxiways, aprons, clearance areas, and zones for navigational aids and other similar functions.[191] This zone is clearly separate from the terminal area, which handles the circulation of passengers, luggage and other goods and includes the terminal building, approach roads, parking areas and service buildings. Hence, the airport creates a large technological system, which is divided into several subsystems with their individual circuits. These systems and their strategy of coordination depend on the successful manufacture of the loops, which secure an environment where coherences are sustained

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[189] *Discussion on information, communication and feedback controls is best exemplified by Norbert Wiener's* Cybernetics: Or, Control and Communication in the Animal and the Machine *(1948). Wiener developed his influential cybernetic theory while designing and analyzing gunfire-control devices during the war. The central concept of cybernetic theory is negative feedback, which uses temporal and spatial controlling signals to compare the interim state of the object with the path to the eventual goal, and predicts and modifies behavior so that this goal is reached. This discourse on control and feedback was subsequently applied in sciences and management. Hughes 2004, 90-95; Wiener 1948.*

[190] *Law studies a similar image of an airport in Law 2002, 27; Circulation at Dulles, Publicity binders, box 497, folder 1367, Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[191] *Airport Development Planning: Air Terminals 1961, 159.*

without distorting what is passed through the loop[192]. This is the founding organizational principle of the airport and its circulation.

Circulation is a seminal concept when airport architecture is discussed in terms of the flow of people, aircraft and luggage through the terminal, the airfield and the approach routes. As Adrian Forty has shown in his study on scientific and mechanic metaphors in architecture, circulation is a term derived from physiology to describe movement within or around a building. Scientific metaphors such as circulation, structure and function were only adapted to architecture in the latter part of the nineteenth century even though William Hardy had used circulation to describe the movement of blood around the body already in 1628, and the term had since been adapted to other fields such as economics. Other and probably more suitable terms such as respiration would have been available, but circulation was chosen to describe buildings as complete and self-contained entities with an autonomous system of inner circulation. Circulation approximated architecture to a scientific practice as it allowed the isolation and abstraction of specific features from the building and subjected them to independent analysis. Mechanic metaphors such as compression, stress, tension, torsion, shear, and equilibrium were likewise used in descriptions of architecture's formal and spatial features as the same terms described human emotions. Thus, spatial experience evoked an emotional response.[193]

According to Forty such terms are symptoms of the modernist trend toward scientization of practice. They make architecture seem as science but, interestingly, at the same time confirm that architecture is not a science since successful metaphors only work when an image is borrowed from one schema of ideas and applied to another, previously unrelated one. Hence, scientific and mechanic metaphors confirm the unlikeness of architecture and science and they entered architectural discourse only after 1850, when a conceptual distinction between the two fields was established.[194] In the case of the airport the concept of circulation enabled architects like Saarinen to isolate specific research areas from the architectural problem and study them "scientifically." Mechanic metaphors were likewise utilized to associate especially the expressive forms of the TWA Terminal with flight. Therefore it is unsurprising that the critique and discussion surrounding the building concentrated on the form and its emotional qualities, not its functionality as an airport terminal.

Second, airport as a large technological system could be analyzed with the aid of systems analysis. Systems approach, which was developed for the production and management of complex weapons systems, and subsequently adapted to other areas of science and business management, views systems as networks of components, which the system builder manages in order to control the environment and keep the system intact.[195]

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[192] *Law 2002, 26-28.*

[193] *Forty 1999, 213-228.*

[194] *Forty 1999, 213-228; for a discussion on the relation of architecture and science, see also* Architecture and the Sciences: Exchanging Metaphors*, 2003.*

[195] *Civil sector adapted technological and managerial changes initiated by the 1950s Intercontinental ballistic missile (ICBM) systems development. Most notable of the new approaches initiated was the Program Evaluation and Review Technique (PERT), which utilized computers to schedule, control and*

Seen as a large technological system, the airport expands from the buildings and aircraft on the airfield to organizations such as design studios, aircraft manufacturers and airport management; scientific components like architectural theory and aerodynamics; and legislative artifacts such as laws governing construction and aviation. Furthermore, airport is just one node in the expanding network of airports in various geographical locations. Systems approach then quickly demonstrates how the airport is a fusion of the realms of technology and architecture and how every architectural component is matched with a technological one.

Systems analysis views components of such large technological systems as interdependent, socially constructed artifacts, which system builders unify and centralize in order to control the environment. Since system builders created the organizational components of the system, context or the environment cannot explain them. Rather the environment constitutes what is not yet controlled by the system. Furthermore, technological systems incorporate subsystems linked by internal interfaces and flows of inputs and outputs. The function of humans within the system is to develop it and correct errors by completing feedback loops between the system's performance and its goals. Instead of a contextual analysis, systems approach then proposes that the evolution of a system, such as the jet engine or the airport, is followed through phases of invention, development, innovation, transfer, growth, competition and consolidation. Yet, it questions technological determinism that might be evoked by the momentum technological innovations seem to posses when described in such terms. The idea of a system of interdependent components explainable only from the viewpoint of the system notwithstanding, this approach is probably more suitable for description of commercial technological innovation such as the jet engine. Yet, viewing the airport as a large technological system is relevant for the study of the airport as infrastructure, and to the analysis of the typological instability of the airport.[196]

Perhaps a more suitable approach to describing the airport as a large technological system is Edward W. Constant's view of systems as a number of subsystems, which in turn are composed of an immense variety of components. In his analysis Constant shows how the aircraft has a major subsystem, its turbojet engine, which in turn is composed of a large number of components such as compressor, combustion system and turbine. This system is decomposable into subproblems that may be isolated and solved individually. Hence, new valve, new turbine material or fabrication technique may represent a revolutionary solution to a specific subproblem, but is an incremental improvement on the level of the total aircraft system. Furthermore, such complex hierarchical systems include

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coordinate projects involving numerous contractors and subcontractors. Several organizations and universities, e.g. Massachusetts Institute of Technology (MIT) cultivated the systems approach and associated managerial techniques including systems engineering (management of the design and development of systems), operations research (quantitative techniques to analyze deployed weapons systems) and systems analysis (methodology to compare, contrast and evaluate proposed projects). Hughes 2004, 77-83.

[196] *Hughes 1987, 51-56, 76-81; Hughes 1983, 2-17.*

not only multiple traditions of practice, but also various communities of practitioners.[197] In the case of the airport, the airport terminal and the control tower are examples of subsystems that were isolated as separate design problems to be solved according to different design criteria. The mobile lounge is another subsystem within the airport that was proposed as a unique solution to the problem of linking the aircraft with the terminal building in the most efficient manner. The mobile lounge is then continuously maintained according to its own criteria of improvement. On a larger scale, the air transportation system in its totality includes at least airplanes, airports, terminal buildings, maintenance facilities, NAV/COM and air control systems, and an immense variety of specialized, coordinated personnel and –surprisingly uncoordinated passengers.

Another theoretical model to study the airport as a large technological system or network is the Actor Network Theory (ANT), developed most notably in the work of Michel Callon, Bruno Latour and John Law. ANT does not presuppose distinctions between a system and its environment or animate and inanimate elements, but instead argues that successful technological innovation, which in this study extends to architectural innovation, is a heterogeneous and complex process involving construction of durable links and networks between human and nonhuman, indifferent or hostile entities. The difference to systems approach is the emphasis placed on conflict and the acknowledgement of nonhuman entities as active *actants*.[198]

In a process, which John Law calls "heterogeneous engineering," innovators do not simply work with material but establish durable commitment to the technology among interested parties, and associate entities as varied as humans, artifacts, skills and natural phenomena. This process involves testing the resistance of different elements in the network and its success depends on the dissociation of hostile forces and their transformation and association with the enterprise. The solidity of the network results only from an architecture in which every point is at the intersection of two networks: the one that it simplifies and another that simplifies it.[199] Ultimately then the durability of the network is measured by the strength of its links, and the extent of the network is defined by the range of actors operating as a unitary force to influence its structure.[200] The airport and its architecture extending through the air routes may be approached, as I do in chapter four of this study, as a network involving not only architects and aviation specialists but also nonhuman *actants* such as the aircraft. Similarly, Saarinen is in chapter five of this study viewed as a "heterogeneous engineer," who labored to convince others of his technologically advanced airport architecture.

However, Actor Network Theory does not provide a clear methodology for the study of architecture as a network. Rather, ANT is best understood as a vocabulary for describing technology –or architecture –beyond the customary dichotomies of natural and social, scientific and political, content and context. Instead, a symmetrical and thick description of every *actant* is required to understand the network. As methodology Law

[197] *Constant 1987, 224-228.*

[198] *Callon 1987, 83-103, especially 93-96.*

[199] *Law 1987, 111-134.*

[200] *Latour 2005, 71, 219*

proposes the study of conditions and tactics of "heterogeneous engineering" that result in a network of juxtaposed components. On his part Latour suggests that actors should be followed when they extend networks, mobilize and displace *actants,* and build durable links to redefine reality.

According to Latour, the expansion of networks is laborious, costly, and possible only if an *actant* is able to recruit and mobilize others in a mutually beneficial direction. This process, which Latour calls translation, involves negotiations to control, extend, and strengthen the network. Recruitment tactics include the questioning of existing network, visualizing a threat, interpreting interests, and subsequently positioning oneself as the obligatory point of passage for another *actant* to reach its goal. Hence, the process of translation necessarily means distortion as aims are interpreted, grouped together and altered to suit those of others. In the network one *actant* then always represents many others, and the strength of the association with the network determines its durability.[201] Consequently it matters if the *actant* is an intermediary or a mediator as the former simply transports a meaning and the latter transforms it or translates it in a manner that distorts the meaning and makes it suitable for the mediator's own needs and interests. Furthermore, Latour points out that the attribution of credit does not always address all contributors involved and describes the complicated process through two mechanisms. Primary mechanism analyzes the extension of networks and secondary mechanism the attribution of responsibility and credit. While Latour's ideas do not necessarily form a clear methodological toolbox, the work of these mechanisms finds its clearest description and application in Latour's study on Pasteur and his laboratory.[202] In this study I extend this type of analysis to Saarinen's architectural office and view it as a laboratory for a new architecture.

Latour has suggested that this type of analysis may also be extended to the discussion on modernism. He argues that modernism is constituted on a dichotomy between human subjects and non-human objects, which is maintained by the polarities of nature and society. Hence, the modern constitution cannot recognize *actants* (which he defines as hybrids blending natural, social and discursive elements) without loosing its integrity. But denying the existence of hybrids causes them to proliferate in an ever-increasing speed and in multitudes that have led the modernists' classification system of natural and social phenomena to collapse. Latour criticizes the anti-moderns, who always shared the moderns' system while holding on to tradition, and the postmoderns, whose despair, irony and allusions he views as a symptom of the moderns, who no longer share the modern beliefs but are yet unable to replace the system with something else. Instead Latour claims that we are non-modern, since the hybrids have always been proliferating and, in fact, have never been modern, since on hindsight we may acknowledge this, correct and save what is valuable of the modern constitution, and move on. Thus, modernism is denounced when the practice of translation (the expanding networks of hybrids) and the practice of purification (the modern critical stance and dichotomies) are considered simultaneously and each agent is viewed as a mediator capable of translation, not an intermediary. The

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[201] *Latour 2005, 173-174; Latour 1987, 108-132.*

[202] *Latour 1988 (1984), 195-200; Latour 1987, 71-74, 118-119.*

center of networks and hybrids then becomes the space through which the dichotomies are explained, not vice versa.[203] In a similar manner, acknowledging such hybrids in architecture permits a critical analysis of how architects relate to technologies and materials. It allows us to notice other interpretations of modernity proliferating outside the one dominating the historiography of modern architecture. Such interpretations of modernity outside the dominant discourse of modern architecture are evident in my discussion on the historiography of the airport terminal.

While ANT has provided insight into the study of science and technology, its application in the study of architecture is somewhat limited. ANT is a useful analytical tool in describing how architectural networks are constructed, but the description of unintentional nonhuman *actants* is useful only as far as it is reasonable to describe aircraft, the jet engine or concrete as actors in a network. According to Albena Yaneva, the *actants* in architecture may be as various as client demand, city politics, user's expectations, site location, program, city fabric, environment, circulation, materials, construction techniques, professionals groups, building code, corporate organizations, and the intended user of the building. The architectural object is thus acknowledged as a social actor.[204] Hence, it is not only professionals that organize the society in their practice, or the society that constrains architecture, but also the architectural object that spatially organizes society and actively transforms and stabilizes the users and practitioners of architecture. This does not simply mean a naïve idea of an empowered object, but an architectural object defined as a heterogeneous, expanding network of social, natural and discursive practices transforming and stabilizing entities involved in its formation.

Saarinen's airports offer an illustrative case study for this type of Actor Network analysis as his airport designs include controversy over engineering defeats: experimental structures extending the limits of not only architectural expression but construction techniques. Analysis of the airports' "heterogeneous engineering," including negotiations about form and structure, may then provide a thicker description of the design process and allow a study of architecture as institutionalized knowledge similar to technological knowledge. Furthermore, Saarinen's mobile lounge concept for Dulles International Airport is an example of a situation where an alternative design solution created controversy and dispute over the development of airport typology.

What is proposed in this study is the acknowledgement of architecture not only as an artifact but also as institutionalized knowledge constructed in a network of heterogeneous entities. Architectural modernisms –and individual buildings –are then understood as knowledge claims formulated within the network of architectural discourses and design practices. Furthermore, the airport terminal building is not only an architectural but also a technological object. The airport in its entirety is a technologically complex structure, and therefore it is relevant to understand how architects approached the airport design problem and how they addressed technology. Hence, the airport is in this study defined as a large technological system and a node in the networks of architectural practices and discourses, technologies and traffic routes. A study about the airport terminal's placement in the

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[203] *Latour 1993 (1991), 10-11, 59-62, 77-82, 133-142.*

[204] *Yaneva 2005.*

historiography must then address these networks to a sufficient degree in order to understand the airport terminal's specificity as modern architecture. Such a description is proposed in the following chapters addressing first the imaginaries of the airport terminal, then the actual history of the building type and finally the way Saarinen labored as a "heterogeneous engineer" to resolve contradiction between modern architecture and its antithesis –the modern airport terminal.

3. The Historiography of the Airport Terminal

Twentieth century was the century of flight. The history of aviation begun on December 17, 1903 when Wilbur and Orville Wright succeeded in flying their Wright Flyer for twelve seconds over a distance of 120 feet in Kitty Hawk, North Carolina. In the Golden Era of aviation, flight was associated with the romantic imagery of adventure, magnificent aircraft, courageous pilots such as Charles Lindbergh and Amelia Earhart, and the awe of flight. Technologically the airplane advanced from a pioneering flying machine to a modern jet aircraft in fifty years. Hence, the airport as an organizational space for aviation and the airport terminal as its landmark building, offer an interesting case study in the historiography of architecture. Did the aircraft have an impact on architecture and urban planning? Was aviation addressed in the historiography of modern architecture? And how did the architects and historians of the modern movement view airport terminal as a new building type?

Interrogating the historiography of modern architecture reveals a paradoxical approach to the aircraft. First, the aircraft's impact on architecture is not discussed in the histories, although the architects' fascination with aviation is evident in other types of historical documentation. Second, historians failed to take notice of aircraft and aviation, although the aerial view's potential for urban planning and the aircraft's functionality, based on aerodynamics and the performance of materials, were not of minor consequence for architecture. Third, historians ignored the emerging building type of the airport terminal, although it was the most modern building type imaginable in the twentieth century. Hence, airport terminals were not included in the canon of modern architecture. The aim to read the historiography in relation to the airport terminal and the aircraft is then frustrated from the beginning. Rather the task becomes one of stating the absence.

As the airport terminal only entered the narrative of modern architecture in the sixties, it is important to analyze the ruptures and silences, unfitting phenomena and disruptive moments in the narrative as points where the airport terminal could have entered the canon of modern architecture earlier. These ruptures then function as clues to its absence and are in this study approached with the aid of microhistory. According to Carlo Ginzburg, this methodology observes on a microscopic scale and creates narratives with evidence reconstructed out of details, clues, absences, silences, doubts, and uncertainties found in the web of incomplete historic documentation. It sees potential in the most improbable documentation and studies the anomalous instead of the analogous. Hence, the limitations of the necessarily fragmented historic documentation are transformed into the constituent elements of the narrative structure. The microhistoric paradigm claims that every phase in research is constructed, including identifying an important object, elaborating categories of analysis, and selecting criteria of proof and narrative forms to transmit the results to the reader. However, unlike postmodernism, microhistory does not study fragments in isolation, but instead insists on the importance of the context as a space for integrating the evidence. Thus, microscopic analysis aims to grasp what eludes a macrohistoric, comprehensive vision and moves between these two scales to reveal the fundamental discontinuity and heterogeneity of reality. The relationship between the microscopic dimension and the contextual then becomes the organizing principle of narration.[205]

In this study the voids in the narrative structure of modern architecture function as clues for the airport terminal's absence in the historiography. Noting these voids I follow the non-conforming phenomena and find evidence in other types of written documentation such as alternative histories, architects' testimonials, architectural plans, models and drawings, and the actual built environment. These documents are evidence of the airport terminal's relevance to the architects and the modernists. However, the material I use to reconstruct the history of the airport terminal is not as spare and fragmented as material available to narrate, for example, the story of a medieval peasant. Rather, my evidence is dispersed, contradictory, and gathered from various sources including planning manuals, histories of aviation and layers of built airport architecture. Hence, this study does not strictly follow the methodology of microhistory utilized in some histories of marginalized phenomena or individuals, but is rather inspired by microhistory.

Ginzburg compares the methodology of microhistory to that of detective work, psychoanalysis and attribution of artwork. These methodologies are based on empirical evidence such as marginal details, clues and symptoms, which are identified and followed until enough evidence is discovered to narrate the results of the investigation. This form of working with evidence resembles that of hunting or tracking, identifying a person with handwriting or fingerprints, and diagnosing illnesses in medicine, but differs substantially from the type of evidence discovered through experiments and testing of hypothesis in the natural sciences. While natural sciences concentrate on pure phenomena and exclude smells, tastes and individuality from experimentation, medicine for instance defines its method based on the explicit notion of the symptom and maintains that histories of individual diseases are developed only if symptoms are observed and recorded. According to Ginzburg, the historian's knowledge is similarly indirect, presumptive and conjectural. Traces aid the historian to comprehend the otherwise unattainable reality, since clues and pictorial marks work like medical semiotics permitting the diagnosis of a disease inaccessible to direct observation. This kind of consideration of details and marginal data also alters the criteria of proof and allows other types of evidence to support the argument.[206]

Ginzburg defines context as the space of historical possibilities, which allows the historian to integrate the evidence. As the historian never has a direct approach to reality, he uses a specific interpretative framework, a code according to which the evidence is constructed. Hence, evidence is like a distorted glass and without a thorough analysis of its inherent distortions a sound historical reconstruction is impossible. Furthermore, documents are never neutral and therefore processes of encoding must be understood in

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[205] *Ginzburg 1993, 22-24, 32-33; Ginzburg 1980 (1976), 110-112.*

[206] *Ginzburg especially discusses the work of Sigmund Freud, who was a neurologist by training, and that of the physician and art connoisseur Giovanni Morelli, who attributed artwork based on the analysis of trivial details such as the painting of earlobes, and fingernails. He further draws a parallel to the detective work of Sherlock Holmes written by the physician-author Arthur Conan Doyle. Thus, the uniting educational background of these methodologies is found in medicine. Ginzburg 1989 (1986)a, 96-108.*

order to interpret the evidence and know what it is evidence of. Hence, the historian must read and exploit gaps to reconstruct processes and phenomena through the clashes and inconsistencies found in documentation. It is these discrepancies and the gaps that provide evidence of another cultural reality.[207]

This fascinating approach to the writing of history compliments the foucaultian approach and results in an analysis that does not isolate fragments but studies them in a manner that makes it possible to discover the "meaning" of a historic period and its artistic objects (in this case airport terminals as architectural objects).[208] Indeed, Ginzburg claims that even a limited case can be representative in the sense that it reveals what is in the statistical majority and defines the latent possibilities of something otherwise known only through fragmentary and distorted documents.[209] It could then be claimed that the dominant architecture culture of the postwar years, the International Style, was countered by minor practices that could be understood through other types of documentation not included in the historiography of modern architecture. This approach is especially valuable for a study of the airport terminal as a building type excluded from the historiography of modern architecture. Hence, in this study I read the histories through the aircraft. Layers of silence, questions, clues and evidence guide the research further and organize the material into a narrative structure that aims to address each layer of stories in the order they were discovered. My aim is not necessarily to fill in the gaps but to build the incompleteness, the questions, and the process into the constituent elements of the narrative. In this sense, the aircraft is allowed to enter the historiography through its gaps and explore its silences in order to discover the airport terminal as the blind spot of modern architecture.

In the case of the airport terminal reading the silences in the historiography suggests an entrance point into a different historical reality, an alternative narrative that lives along the dominant view of modern architecture. This silence is echoed by other gaps in the narrative of modern architecture, most significantly the absence of alternative mediations of modernity. But of what are these gaps evidence? What does their existence suggest of the historiography in relation to the airport terminal? It is of importance to understand the

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[207] *Ginzburg 1989 (1986)b, 160-161; Ginzburg 1994, 294-295, 301.*

[208] *Michel Foucault has studied the exclusions, prohibitions and limits through which our culture historically came into being, but Ginzburg claims Foucault is primarily interested in the act and criteria of exclusion. Following Jacques Derrida Ginzburg argues that it is factually impossible to interpret and analyze the excluded in the language of the dominant suppressing culture. Instead, other types of evidence is available that enables the reading and reconstruction of the excluded in relation to the dominant culture. Ginzburg 1980 (1976), xvii-xix.*

[209] *The microhistorical approach is then in direct opposition to quantitative and serialized history, which utilizes statistics i.e. anonymous numbers to study subordinate classes. Furthermore, Ginzburg claims that this approach maintains the silence and does not acknowledge that in any society access to the production of documentation is conditioned by a situation of power. Instead, studying for instance an insignificant but therefore representative individual, as Ginzburg has done in the case of the sixteenth-century miller, may offer a relevant and illuminating viewpoint into the entire period. Ginzburg 1980 (1976), xx-xxi; Ginzburg 1993, 21.*

depth of evidence the aircraft provides when it is allowed to enter the historiography. In this chapter, I will first read the histories of modern architecture through the aircraft, and then discuss the modern technophiles, the history of the architect's interest in airplanes, and the utopian early visions for airfields.

3.1. Interrogating History

First-generation histories of modern architecture include a few references to hangars and aerial views, but do not discuss them in detail or reflect on their impact on architecture. There are no references in Emil Kaufmann's *Von Ledoux bis Le Corbusier: Ursprung und Entwicklung der autonomen Architektur* (1933) or Nikolaus Pevsner's *Pioneers of the Modern Movement from William Morris to Walter Gropius* (1936). Adolf Behne's *The Modern Functional Building* (1926) includes one plate, Eugène Freyssinet's concrete and steel hall for dirigible airships at Orly (1924), and a footnote that quotes Adolf Loos claiming: "To change a form when no *sachlich* improvement is possible... is the greatest absurdity. I can only invent something new when I have a new problem, in architecture, for example: a building for turbine, hangars for airplanes. But a chair, table, wardrobe? I will never admit that we, for the sake of the imagination, should change forms tried and tested over centuries."[210] This quote is not discussed in the text, nor are its implications reflected upon. Yet, it is interesting to see that Loos acknowledged the challenge aviation posed for modern architecture. Furthermore, this quote reveals that while first-generation historians failed to acknowledge the aircraft's impact, architects were interested in aviation and viewed the hangar as a novel and typically modern design problem.

Sigfried Giedion does not address the airport or the aircraft in any of his pioneering histories. Although one would assume that his interpretation of modern architecture as the physical expression of a new space-time concept in sciences was at least partly inspired by the air view and the experience of flight, instead, *Space, Time and Architecture: The Growth of a New Tradition* (1941) explains the new space concept with reference to modern math, physics, natural sciences and structural engineering. When Giedion discusses the Futurists' experimentations with the visual representation of simultaneity, multiplicity and distortion of objects in movement, he does not mention the Futurists' fascination for aviation. Neither does he discuss the seminal role the aircraft played in the "Futurist Manifesto" and other writings by Filippo Tommaso Marinetti. Walter Gropius's Bauhaus in Dessau (1926) is published as a realization of the space-time concept with an air view and this caption: "This air view shows how the different units blend together. The eye cannot sum up such a complex at one glance."[211] Thus, air view is mentioned as evidence of the impossibility to view architecture from a single viewpoint, but the radical effects of the aerial view are not discussed.

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[210] *Avant-garde architects, who also had an extensive literary oeuvre paid more attention to aviation. These writings will be discussed later. Here the focus is in the canonical histories of the modern movement. Behne 1996 (1926), 134-135, 198.*

[211] *Giedion 1956 (1941), 439-444, 488.*

The ultimate space-time experience for Giedion is still cruising along the highway in an automobile. Giedion celebrates the parkway as an expression of the space-time concept, simultaneity, and movement in the urban environment. This movement is that of an automobile, not flight of an airplane, as few modernists had experienced flight but were familiar with the speed of cars and the aesthetics of the automobile, the locomotive and the ocean-liner. Nevertheless, highways are illustrated in air views and Giedion writes: “The space-time feeling of our period can seldom be felt so keenly as when driving, the wheel under one's hand, up and down the hills, beneath overpasses, up ramps, and over giant bridges.”[212] He then suggests that the space-time experience is tactile, and involves control over speed, movement, and technology. While flying would definitely comply with his definition of the space-time aesthetics, the experience of control over speed and the technological artifact was –and remains, limited to the pilot.

The aircraft never became a machine that most people operated, although many envisioned that in the early years of aviation. Most people witnessed flight at aerodromes, and, gradually, a growing number of people flew onboard small aircraft. “Air-minded” became a popular term that referred to the early aviators and anyone fascinated with aviation. Descriptions of the new bird's-eye experience, including those written by Le Corbusier after his late 1920s and early 1930s flights in Europe and South America, are documented in a variety of books and periodicals. This demonstrate that a fleeting feeling of control over flight was experienced even by a passenger onboard a small three-person airplane of the kind Le Corbusier, for instance, would fly with in South America. But Giedion’s space-time concept does not include this experience of the vertical dimension; it is bound to the earth. He failed to acknowledge the importance of the technology that would significantly alter the way people experience space and time.

Giedion does not include aircraft as a scientific innovation in *Mechanization Takes Command: A Contribution to Anonymous History* (1948) either, even when he discusses the impact of new technologies in manufacturing and food production, and the revolutionary effect of vacuum cleaners, refrigerators, dishwashers and mechanical garbage disposer in modern households.[213] However, the air view is mentioned in “Nine Points on Monumentality,” an article he published with Louis Sert, and Ferdinand Léger in 1943. In the context of postwar reconstruction, they acknowledged that air views revealed the lyrical value of cities and emphasized the importance of planning total landscapes visible from the air.[214] Thus their comments reflect the devastation of cities visible in aerial photography, and the sentiment of the postwar period faced with the enormous task of rebuilding cities and re-erecting symbolic monuments.

The second-generation historians of modern architecture did not introduce the airport terminal into the canon of modern architecture, even though this might have been expected of the technology enthusiast Reyner Banham. First, the absence of the airport terminal is partly explained by the simultaneous emergence of the novel building type. Second, not many prominent airport terminals were constructed within the timeframe of the histories

[212] *Giedion 1956 (1941), 730, 732-733.*

[213] *Giedion 1948.*

[214] *Giedion & Sert & Léger 1993 (1943), 29-30.*

focusing on functionalism. Only a small number of public airports were built before the 1930s and while some of the terminal buildings complied with the stylistic tropes of modern architecture, none of them could be considered as a seminal building by a leading modernist. The typology of the airport terminal was still evolving and the buildings erected on the side of the airfield did not correspond with the criteria of the canon formation. However, several airport terminals, especially of the thirties, were introduced in architectural magazines and architects were increasingly evaluating the quality of the buildings erected on the airfield.[215] Thus, there was publicized material available about the airport, but while second-generation historians questioned the narrative of modern architecture, the terminal was not seen as a building type crucial to modernization or the evolution of the modern movement.

The histories by Bruno Zevi and Peter Collins, or the earlier books by Henry-Russell Hitchcock do not include any reference to airports or aircraft.[216] Manfredo Tafuri's histories do not refer to the aircraft, nor the airport, but Tafuri and Francesco Dal Co's *Modern Architecture* (1979) includes some images of airports and discusses Saarinen's TWA Terminal from a formal point of view. However, it does not address the functional layout of the airport.[217] Banham's *The Architecture of the Well-Tempered Environment* (1969) discusses technology, but focuses on technical appliances and structural innovation in modern building instead of new technologies like the aircraft. However, Banham's other histories mention the airport.[218]

Banham's seminal *Theory and Design in the First Machine Age* (1960) emphasizes the importance of the Futurists, whose ideas were significantly inspired by aircraft and other novelties of the technological era. In fact, the greatest value of Banham's history was his inclusion of the Futurists and their visions in the history of modern architecture. *Theory and Design in the First Machine Age* does not explicitly discuss the aircraft or the airport, but includes previously unpublished images of urban plans with airfields. Importantly, the book features images of Antonio Sant'Elia's *Stazione Aeroplani* (1912) and *Città Nuova (1913-1914)* traffic center and airship hangar (1913), cites the Futurist manifestoes and describes the landing strip between the two skyscrapers as suicidal.[219] Banham publishes an image of *Une Ville Contemporaine* (1921-1922) and discusses briefly the similarly suicidal aircraft landing-deck in relation to Sant'Elia's plan. In his analysis of le Corbusier's *Towards a New Architecture* Banham criticizes Le Corbusier for not discussing penetration, controls, or streamlining in relation to the aircraft when these issues are later brought up with reference to cars and other modern machines. In the concluding chapter Banham mentions the Heinkel He 70 research aircraft and the Boeing 247D transport aircraft as examples of machines that broke the visual link between

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[215] *See for instance* Architectural Forum *(July 1930) for Hamburg Fuhlsbüttel Airport;* Architectural Review *(July 1937) for Municipal Airport of Ramsgate;* American Airport Design *1990 (1930); Wood 1940.*

[216] *Hitchcock 1993 (1929); Hitchcock & Johnson, 1995 (1932). Zevi 1978.*

[217] *Tafuri & Dal Co, 1979, 378.*

[218] *Banham 1969.*

[219] *Banham 1980 (1960), 116-119, 132-133.*

International Style and technology.[220] He could have also utilized existing airport terminals, such as D. Pleydell-Bouverie's Municipal Airport of Ramsgate (1937), as examples of architecture's imitating relation to the "machine," but this or other existing terminal buildings were not mentioned. Nevertheless, because of his interest in technology, and probably because he had worked as a draftsman in an aeronautical plant, Banham was the first historian to notice moments when the development of aviation and modern architecture intertwined.

Banham's later *Age of the Masters: A Personal View of Modern Architecture* (1962) introduces Saarinen's TWA Terminal and Dulles Airport as some of the finest examples of postwar architecture. Banham claims that Saarinen created "the only two airport buildings of the post-war years that really stand out from the enormous number of passenger terminals and the like that have been put up in the last quarter century." In his view the TWA Terminal not only functioned better than most terminals at the Kennedy Airport, but also captured the high period of the so-called "Romance of Air Travel." Dulles, in turn, worked out some problems related to the future of the airport. In Banham's words TWA is "as competent and imaginative a solution to the problems of the day [the late fifties] as any architect ever achieved, plus a striking symbol of jet-age glamour." In his design for Dulles, Saarinen developed the functional organization of the airport further. According to Banham, its terminal building is entirely and essentially a monumental space, with embarkation lounges transporting passengers directly to the plane. Dulles in his view was then suspiciously nearly perfect.[221]

In the same book, Banham pays attention to the myth of the engineer as the noble savage of the "machine age." He also mentions Eugéne Freyssinet's airship hangar at Orly (1916) and Pierluigi Nervi's aircraft hangar in Orvieto (1936). Furthermore, he connects the changing concept of architectural space with the development of first, the railways and then, aviation. He notices how railways have shrunk distance and allowed travel beyond any conceivable architectural compositions in a relatively short time. Lindberg's flight over the Atlantic created continental connectivity at the time when space-time and fourth dimension entered discourses in the sciences and the arts. Thus, gradually space became infinite but at the same time measurable. Visible structures and geometry suddenly formed a special, moving relationship to the observer and thus defined space in new terms.[222]

Curiously, Hitchcock includes a few airports in his sketch of the mid-twentieth century architecture scene published in the 1977 edition of *Architecture: Nineteenth and Twentieth Centuries*. Saarinen's Dulles Airport is acknowledged as a culmination of his career along the Ezra Stiles and Samuel F. B. Morse College at Yale. Hitchcock also mentions Rio de Janeiro's Santos Dumont Airport designed by the Roberto brothers in 1938-1944, the San Juan Airport, completed in 1955 by Torro, Ferrer & Torregrossa in Puerto Rico, Minoru Yamasaki and Joseph W. Leinweber's St. Louis Airport, and Enrique del Moral's Acapulco Airport. The first two are mentioned because of their elegance in materials and compact, circulation-based plans, the latter two for their concrete shell vaults and dramatic

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[220] *Banham 1980 (1960), 237, 242, 253-255, 328.*

[221] *Banham 1975 (1962), 122-125.*

[222] *Banham 1975 (1962), 44, 50-51.*

form making. Thus, this reading enforces Hitchcock's interpretation of the rational and the contradicting emotional approach in mid-century architecture.

Hitchcock notes how many building types, including facilities for transportation such as bus stations and airports did not exist in the 19th century. Therefore, the writing of their history and evaluation of the quality of their architecture is more complicated. In his view, mid-twentieth century was not successful in bringing the airport as a building type to maturity. The airport did not yet find a supreme expression, partly because expanding traffic made the airports inadequate so quickly and constant expansion blurred the integrity of the original architectural concept. In his view, Midway Airport in Chicago and Kennedy Airport in New York could not rival the century-old railway stations as masterpieces of architectural organization. The constant rebuilding of airports had in his view been particularly fast since the sixties and would resume again once the supersonic aircraft would become operational in the 1970s. Nevertheless, the design of airports was in his view stabilizing along the criteria of International Style. It could then be said that the "classic" stage in airport design, reached in railway stations between 1845 and 1855, was forming in the late fifties.[223] Hence, at the time when the seminal histories of modern architecture were written, the airport and its terminal building had not yet, in the minds of the historians, reached a prominent status.

One exception among the histories of modern architecture is *Forms and Functions of Twentieth-Century Architecture* (1952), edited by Talbot Hamlin. This ambitious book maps out modern architecture through building types. Bridges and highway architecture, railroad stations, airports, air stations, seaports and ship terminals, bus stations, and garages and service stations are discussed under the function of transportation. Yet even Hamlin acknowledges the problems associated with writing about aviation architecture: "The most novel problems have derived from the growth of aviation. This development is as yet in its infancy; the increasing speed and size of planes seem to demand continual changes in airport areas and layouts… so fluid is this problem that any treatise concerning it is necessarily time-bound by the date of its composition… the chapters in this section cannot, therefore, be final."[224] In his analysis of the air station, discussed as a separate planning problem from the airport, Albert Frederick Heino defines an air station as a "building or group of buildings used for unloading and loading of aircraft and the transfer of passengers and cargo to or from ground transportation." He points out how the lack of standardization in equipment and in handling procedures has created serious problems in designing and financing ground facilities.[225] Heino discusses the Tempelhof (1925, later terminal 1937), Croydon (1928), Moscow (1930), Munich (1931), Brussels (1932), Venice (1935), Amsterdam-Schiphol (1936), Paris-Le Bourget (1937), and Copenhagen-Kastrup (1939) airports in Europe as well as Washington-Hoover (1928), LaGuardia (1939) and Washington National (1937) airports in the United States. However, *Forms and Functions*

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[223] *Hitchcock 1987 (1958), 555, 569-570, 588, 590, footnote 10a.*

[224] *Other functions are commerce and industry, public health, social welfare and recreation, buildings for residence, buildings for popular gatherings, buildings for education and government buildings.* Forms and Functions of Twentieth-Century Architecture *1952, 399-400.*

[225] *Heino 1952, 507-547, quote from page 507.*

of Twentieth Century Architecture, which provides guidelines for planning, tends to be more of a design manual than a history of modern architecture.

Even when the airport was not included in the histories, some utilitarian buildings were discussed in the annals of modern architecture. For instance, grain elevators dotting the American continent were influential for the modern aesthetics of pure, undecorated and functional forms. Banham discusses these in detail in *A Concrete Atlantis: U.S. Industrial Building and European Modern Architecture, 1900-1925,*[226] and Giedion in passing in *Space, Time and Architecture.* In addition Giedion pays special attention to the developments in bridge construction.

The railway station also occupies a place in the histories of architecture as a nineteenth century building type, where iron and glass were used to create functional modern structures to shelter the railroad tracks behind a masonry frontispiece. They are discussed in different countries and decades in Hitchcock's *Architecture: Nineteenth and Twentieth Centuries.*[227] In *Mechanization Takes Command* Giedion describes especially railroad furniture in detail as an example of functional patent furniture. At the end of this discussion he even criticizes a single adjustable folding chair used in airplanes in 1936 for an "artificially heavy appearance."[228] In *Space, Time and Architecture* Giedion mentions Tony Garnier's Central Station Plan of 1901-1904 as a building exploiting new materials of glass and reinforced concrete "at a time when railroad stations were customarily executed in the style of huge monuments."[229] Eliel Saarinen's Helsinki railway station and Paul Bonatz's Stuttgart station are often mentioned as prime examples of railway stations utilizing modern forms, albeit those were modern within the national romantic vocabulary.[230] Railway stations were then not constructed along the tropes of modern architecture, but the building type was mature enough to occupy its place in the history of architecture. Coincidently then, or not, Eliel Saarinen's Helsinki railway station is a prime example of a modern railway station, while Eero Saarinen's Dulles International Airport was a celebrated modern airport. In this sense, the father and the son were constructing transportation infrastructure for the prominent technology of their time.

Interrogating the historiography reveals that utilitarian architecture (and emergent building types such as market halls, exhibition structures and green houses) is mentioned in the histories of modern architecture, but does not hold a prominent position in the narrative. While grain elevators and railway stations are mentioned as predecessors of modernism, organizational architecture for transportation such as the bus station, the gas station and the airport were excluded from the canonical histories of modern architecture. The airport was simply not written into but out of the historiography. In fact, the airport terminal only enters the histories in the 1960s and 1970s, when the building type had matured into a prominent urban structure that could not be ignored and importantly, when the second-generation modernists had designed airports that were considered seminal in

[226] *Banham 1986.*

[227] *Hitchcock 1987 (1958), 178, 462, 544.*

[228] *Giedion 1948, 439-468.*

[229] *Giedion 1956 (1941), 330.*

[230] *See for instance Hitchcock 1987 (1958), 483; Giedion 1956 (1941), 571; Cheney 1930, 111-112.*

their oeuvre. One could argue that only then the airport terminal found an architectural form worthy of the histories, but this is not entirely true since significant airports had been designed already in the first part of the century. It could also be argued that the airport was excluded as it was merely infrastructure, but airports repeatedly involved form giving that went beyond structural necessities. Therefore, it is interesting that the airport terminal as the landmark building at the airports did not enter the history of modern architecture earlier.

Could it be that airport terminals before 1960 were architecturally not as successful as Eliel Saarinen's Helsinki railway station? And if so, why were they so mediocre? I would argue that some airport terminals were architecturally successful and anything but mediocre. However, the architectural vocabulary utilized in these buildings did not coincide with the criteria of the historiography of modern architecture that relied on the functionalist rhetoric. Furthermore, Art Deco, streamlined moderne, and 1930s classicism were not yet seen as legitimate alternative forms of modernism. However, in the current research environment that recognizes the diversity of modernisms, the airport terminal may finally be included in the canon and its stylistic diversity contextualized.

The airport has its history and forms a canon of important and well-designed terminal buildings and airfields, but this history is documented elsewhere. The evolution of the building type needs to be traced in other kinds of histories and other forms of documentation. For instance, the aircraft has a prominent presence in the writings and urban visions of the pioneering modern architects some of which are even mentioned in the histories of the modern movement. Furthermore, several other types of histories address the airport and therefore in order to write the history of the airport terminal, histories of modern architecture are best read alongside histories of aviation, histories of other technologies, and especially cultural histories addressing the aircraft's impact in various fields of culture.

The history of aviation obviously concentrates on the development of the aircraft. Airports are occasionally mentioned but are viewed as infrastructure for aviation. These histories bear an interesting relation to the histories of technology, which are equally fascinated by cutting-edge scientific invention. Both types of history often share a deterministic belief in the evolution of technology and view technological development as a logical and unquestionable process guided by rational selection. While the deterministic view of technology has been widely criticized and dismantled, this type of documentation is still a valuable source of information for a study of the airport terminal. It provides chronological information of the aircraft types, and aids in evaluating the functionality of the airport as infrastructure for aviation. Having said this, it is important to remember that the aircraft is but one of the factors shaping the typological development of the airport terminal. Therefore, these histories should be treated as one form of incomplete documentation aiding the reconstruction of the airport's history.[231]

In the cultural histories of aviation, development of the airport is typically followed in relation to the advancement of the aircraft. These histories seldom concentrate on airports,

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[231] *For histories of aviation see for instance Bilstein 1984. For the discussion of determinism in the histories of technology see chapter two of this study and MacKenzie 1990.*

but instead reconstruct a wider cultural context reciprocally influencing aviation. The impact of the so-called air age of the 1920s and 1930s is viewed through the imagery of aviation in literature, cinema, advertisement, art, fashion and other realms of culture. Cultural histories of aviation include a set of canonized events in aviation history. Most often these are victorious flights of the pioneering aviators and the performance of legendary aircraft such as Charles Lindbergh's crossing of the Atlantic and the landing of his Spirit of St. Louis at Le Bourget in 1927. Along these lives a realm of aviation related phenomena such as jet-plane inspired period terms "jetlag" and "jet set" or clothing styles for stewardesses. Materials developed for military aviation and space exploration, for instance teflon, nylon or gore-tex are followed into their civil application in kitchen supplies, clothing and various construction materials. Classical aviation moments in cinema –the end scene in *Casablanca* (1943), or Leni Riefensthal's *Triumph des Willens* (1935) where Hitler lands in Nuremberg through the clouds –are included in the canon of aviation imagery. Paintings depicting airplanes, comics and science fiction merge with famous photographs of aircraft crashes, and terrorist attacks of the 1970s. Together they form a splendid if peculiar mix of aviation related imagery. These narratives of the aircraft's enormous cultural impact constitute another important source of information of the airport terminal's history.[232]

Airspace is one of the key ideas emerging out of the cultural histories. Airspace refers to a controlled area for a network of airways and flight paths. Positive Controlled Airspace (PCA), between 18,000 and 60,000 feet above sea level, accommodates 10-mile-wide commercial airways monitored by regional and national traffic control centers and instrument-based piloting. Terminal Controlled Airspace (TCA) ranges from the ground level to a safety height between 3,000 and 6,000 feet and is controlled by airport authorities. It comprises the airport with its multiple facilities and is the site of takeoffs and climb-outs, final approaches and landings. However, airspace is commonly used to denote a wider cultural realm addressing aviation in studies on aviation, space, and related politics and aesthetics. In this study the use of the airspace is limited to its more technical content. I use it to address the airspace of flight operations and the impact of such operations on the immediate environment of the airport and its approach areas.[233]

Air-minded i.e. enthusiasm for aviation is another key concept used in the cultural histories of aviation. Air-minded in the broader period sense applies to everyone enthusiastic about the aircraft and its enormous potential. It finds its most compelling representations in the arts and popular culture. Robert Wohl describes extensively aviation's influence on literature and painting, and writes vividly about the romance of early aviators, young aces in the World War I, and the cultural implications of death, competition, and glory in aviation.[234] In Joseph Corn's detailed reading of the air age in America air-minded is transformed into the winged gospel, a cultural phenomenon resembling a religious experience. Corn associates the dreamlike and spiritual imagery of

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[232] *For cultural histories of aviation see for instance Corn 1983; Gordon 2004; Pascoe 2001; Pearman 2004; Wohl 1994;* Building for Air Travel: Architecture and Design for Commercial Aviation *1996.*

[233] *Pascoe 2001, 9-10.*

[234] *Wohl 1994.*

flight with a Christian vocabulary. During the air age, aviation expanded into small towns across America when Lindbergh and other early aviators preached the gospel in stunt shows and celebrity events. As the movement grew more serious, schoolchildren were taught aviation awareness and it was envisioned that soon every suburban house would have an airplane in their garage.[235]

The third major idea in the cultural histories of aviation is the impact of the World Wars that expanded the influence of aviation into other spheres of society. Histories of aviation commonly follow the evolution of the aircraft through the war effort, but the cultural histories place this impact in a wider cultural context. War efforts influenced aircraft production tremendously as the amount of aircraft factories proliferated beyond peacetime demand. In the immediate aftermath of the Second World War these manufacturing facilities were transformed into production of other goods such as housing panels utilizing the technologies and materials common in aircraft production. Aerial photography, which developed during wartime to monitor enemy lines and activities, became a prominent postwar design tool. It was utilized not only to reconstruct cities but also to design them in such a manner that the impact of a glooming nuclear attack could be minimized.[236]

One additional type of literature addressing the airport terminal is the airport design manual. John Walter Wood's *Airports: Some Elements of Design and Future Development* published in 1940 is the most important manual for the reconstruction of airport terminal's architectural history. It describes and criticizes forty-eight period airports and as such forms the basis for a canon of airport architecture. Many airports are omitted, mostly because of their technical faults, but Wood's manual is still the most concise description of airport architecture before 1940.[237] Another major attempt to write a comprehensive study of airports is *Building for Air Travel: Architecture and Design for Commercial Aviation*, which is a collection of selected articles published in conjunction with the 1996 exhibition by the same name at the Art Institute of Chicago. Especially Wolfgang Voigt's article on European airports narrates a concise history of airport construction in Europe before the Second World War.

In the light of these histories, airport terminal is intertwined with cultural elements as varied as the aircraft and its history, architecture, art, popular culture, the chronology of disastrous airport accidents, and fashion trends for stewardess' uniforms. They form the space where the story of the airport terminal is narrated. Tracing the impact of the aircraft through a variety of historical documentation I will next explore the realm of imagination, which gave form to early, utopian visions for airfields as transportation hubs of the future.

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[235] *Corn 1983.*

[236] *See* World War II and the American Dream: How Wartime Building Changed the Nation *1995; Cohen 2011.*

[237] *Wood 1940.*

3.2. Celebrating Machine Aesthetics

The historical documentation of early airport architecture concentrates on the utopian visions of avant-garde architects and other modernists such as Le Corbusier and Filippo Tommaso Marinetti. In general terms, utopia, which was defined as a "good place" (topos=place and eu/ou=good) in Sir Thomas More's book published in 1516, imagines perfection achieved through social planning and stems from discontent with the existing society. A utopia is typically set in a geographically unknown place or future time. Reinhart Koselleck argues that since the 1770s, geographical exploration of the earth forced authors to find "nowhere" in other non-terrestrial spaces such as the moon and the stars, below the surface of the earth, and finally the future. A utopia set in the future assumed temporal continuities and was essentially linked to the empirically redeemable present. It offered social, political, moral and literary compensation for present misery. Thus the imagined perfection of the formerly spatial counterworld was temporalized.[238] Architects, who were inspired by the functionality and aesthetics of twentieth-century technology, propagated architecture that would echo the modern spirit embodied in the sleek machines. These architectural plans did not necessarily imagine a better society, although many of them such us Le Corbusier's *Une Ville Contemporaine* did, but rather set an image of a city made possible by contemporary technology into future, where these cities could be drawn on a tabula rasa without binding realities of the present. These were functional, well-planned cities that might also bring along unspecified socioeconomic advancement.

The Futurists were among the first to address the process of modernization and the immediate positive impact it ought to have on the living environment. Architecture and culture had to portray the lifestyle of the modern man, and the whole society needed to celebrate the modernity of fast cars, airplanes and rapidly changing cities. The aircraft played a central role in the rhetoric of the Futurists and is included in "The Futurist Manifesto," written by Filippo Tommaso Marinetti and published in *Le Figaro* on February 20, 1909. The eleventh proposition of the manifesto states:

> "We will sing of great crowds excited by work, by pleasure, and by riot; we will sing of the multicolored, polyphonic tides or revolution in the modern capitals; we will sing of the vibrant nightly fervor of arsenals and shipyards blazing with violet electric moons; greedy railway stations that devour smoke-plumed serpents; factories hung on clouds by the crooked lines of their smoke; bridges that stride the rivers like giant gymnasts, flashing in the sun with a glitter of knives; adventurous streamers that sniff the horizon; deep-chested locomotives whose wheels paw the tracks like the hooves of enormous steel horses bridled by tubing; and the *sleek flight of planes whose propellers chatter in the wind like banners and seem to cheer like an enthusiastic crowd*."[239]

[238] *Koselleck 2002, 85-88.*

[239] *Marinetti 1971 (1909), 39-44, my emphasis.*

The airplane was the most novel machine in the Futurists' visions. While some of their mechanistic imagery, for example the locomotive, had been around since the nineteenth-century, the aircraft was a true novelty of "the machine age." It did not have any precedents other than the trial machines of unsuccessful experimenters. And enthusiasm for aviation could not begin to develop until 1909, after the Wright brothers had begun to demonstrate their invention publically. While the Wrights had flown their machine in 1903, it was only in September 1905, when they remained in the air for almost 40 minutes over a course of 24.5 miles, that the flying machine had any practical use. Furthermore, only a few people had seen the airplane as the Wright brothers were very protective of their innovation and aimed to patent it (fig. 3.1). They calculated that the flying machine would be an asset to any nation facing war in the future. They tried to sell it first to the American and then the European governments, but were unsuccessful in their efforts. In Europe, the first demonstrably successful flying machine *Voisin Canard* had been flown in 1906, but it really was not before the Wrights' European tour of 1908 that the aircraft could be experienced and eye-witnessed by the masses.

The Wright tour started an unforeseen fascination for aviation. Enthusiasts crowded onto the ad hoc airfields to catch a glimpse of the amazing machine, and other early innovators tried their best to catch up with the Wright brothers. Several inferior machines were flown –and crashed –in a growing number of flying events, speed competitions, and distance raids. Fearless aviators such as the Brazilian Alberto Santos-Dumont, and the French Henri Farman, Léon Delagrange, Count Charles de Lambert, Hubert Latham, and Louis Blériot flew their machines over rivers, lakes, and even mountains. Victories and honorable crashes involved in the deadly sport built up the mythical fame of the early aviators. Some milestones in aviation included Farman's first officially recorded kilometer in a closed circle in January of 1908 and his first cross-country flight between Bouy and Rheims in October 1908. Another milestone was Blériot's crossing of the English Channel on July 25, 1909. A growing crowd followed this flight, which had enormous symbolic importance. It made France the leader in aviation, as it had been in the development in other new technologies such as the automobile, the dirigible and the submarine.[240]

The Futurists expressed excitement for a dramatically different future, which they felt was made tangible in flying events. Marinetti, living in France at the time, published "The Futurist Manifesto" only six weeks after Wilbur Wright had completed his season of flights at Le Mans. Marinetti flew for the first time onboard a Voisin biplane with the aviator Jean Bielovucic in September 1910, and described the experience as having "triumphed over the stickiness of the road."[241] He admired aviators and aviation, which in his view crystallized the experience of living the modern technological era, and emphasized motion, dynamism and transience. Futurists celebrated new technologies such as X-rays and claimed that this particular technology was destructing static vision. Furthermore, in their opinion, architecture should be expendable and transient so that

[240] *Wohl 1994,14-30, 53-57.*

[241] *Wohl 1994, 138-140. The quote translated by Wohl. First published in Italian in Marinetti, F. T., 1968.* Teorie e invenzione futurista. *Edited by L. de Maria. Milan: Mondadori, 136.*

every generation would build its own architecture to replace that of the previous generation.[242]

The Futurists were against the permanent value of a masterpiece and promoted new culture of the men of technology. Marinetti writes: "...One finds today, with increasing ease, men of the people without culture or education, who are nevertheless endowed already with what I call the gift of mechanical prophecy, or the flair of metals. They are workmen who have already undergone the education of the machine, and in some way are affiliated to machinery."[243] But these men were not the educated that made maximum use of technology. Instead they were true men of future, transformed by machinery. The Futurists then envisioned a lifestyle in which art and life merged in a true avant-garde fashion. They propagated this new lifestyle as radically different from the present one, and this provocation was not without political implications. To promote democratic architecture for the metropolis, Marinetti claimed that its lifestyle was that of aviators and cosmopolitan travelers and the Futurist aesthetic was that of "giant locomotives, spiral tunnels, ironclads, torpedo boats, Antoinette monoplanes and racing cars."[244]

"The Futurist Manifesto of Aerial Architecture," published in 1934, added a political, social, industrial, commercial and artistic aspect of aviation into the "Manifesto dell'Architetto Futurista" and proposed a single city of continuous line, such as those admired during flight:

> "We Futurist poets, architects and journalists have conceived the large single City with continuous lines to admire in flight, parallel thrust of Aeroways and Aerocanals fifty meters wide, separated from one another by slender habitation/suppliers (spiritual and material) which will feed into all the different and distinct never intersecting speeds…The Aeroways, by day visible at a distance because of their bright color and at night lit up by ground level lights and floods, will be provided every fifty miles with habitation/suppliers which will stretch on till they meet, at all points touching the lonely pure hygienic countryside hence offering at all points escape and shelter in case of aerial bombardment. The underground aerostations and armored seaplane ports will open into the edges of the Aeroways and the Aerocanals. The Aeroways will run the length of the peninsula, they will slant down from the Appennines to the sea, they will become, on hills and passes, from peak to peak, immense easy mountain landing-strips with numerous panoramic terraces."

Architecture would then have a geometric quality, which could be admired only from the air:

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[242] *Sant'Elia & Marinetti, 1990 (1914), 34-38.*

[243] *Banham 1980 (1960), 123; Marinetti 1971 (1911-1915)b, 90-93.*

[244] *I have here quoted the text from Banham, whose translation differs from that in Marinetti 1971 (1911-1915)a; Banham 1980 (1960), 124. Another interesting vision of cosmopolitan travel was included in Paul Sheerbart's expressionist novel* Glasarchitektur. *In it he described Airports as glass palaces: "airports must be visible and identifiable from far off and this is best achieved by colored ornamental glass." Scheerbart 1972 (1914), 66.*

> "Neither laws of verticality nor laws of horizontality. The buildings in the shape of a sphere, cone, pyramid, straight triangular prism, oblique square prism, scalene triangle, isosceles triangle, polyhedron, lozenge, will have an aesthetic and practical individuality, but will be subject to the dominant theme of habitation/supplier. To people flying over this will appear as an arrow, a ring, a propeller, a crucible, a brilliant, a matrix. It will look funnel-shaped, fibroradiated, radicellular, split-leveled, arborized, scaliform and blown. Special curves will encourage the floating of yellow silk reflections under the sun's rays."[245]

The airplane offered a new way of seeing at a time, when avant-garde artists were exploring new techniques to represent space. Artists outside the Futurist movement also experimented with moving aerial views. For instance, Robert Delaunay utilized photographs of flying events, printed as postcards, to inspire his paintings that frequently featured dirigibles and airplanes flying around the Eiffel tower. Paintings such as *Dirigeable et Tour* (1909) and *Soleil, Tour, Aéroplane* (1913) portrayed a fragmented and multifaceted image of the modern age. Period magazines and posters also featured views from the air to advertise a variety of products, but it was only the cinema that could capture the way the world looked from a moving airplane. Aerial images were popular at cine-magazines and especially the film showing the crash at Issy-les-Moulinauz in May 1911 became famous. Thus, the arts and especially cinema were influential in promoting aviation.[246]

Vivid avant-garde interest in aviation developed in Russia after Grand Duke Alesandr Mikhailovich returned from France in 1909 and promoted aviation. Futurist writer Vasily Vasilyevich Kamensky was the first Russian aviator, but the Futurist circle included also other aviation enthusiasts such as Vladimir Mayakovsky and David Burlyek, who toured the country with performances inspired by aviation. For another enthusiast, the Suprematist artist Kasimir Severinovich Malevich, takeoff and ascent were metaphors for transformation of consciousness, and redefinition of time and space. Pilots and airplanes featured in many of his paintings including *Simultaneous Death of a Man in an Airplane and at the Railway* (1913), *Aviator* (1914), *Formation of Aerial Suprematist Elements with Sensations of Flight* (1915), and *Suprematist Composition: Airplane Flying* (1915). Malevich's interest was in a planetary space of motors, wheels and fuel. He claimed that while the Futurists were influenced by machinery such as airships, locomotives and ocean liners, Suprematists were uplifted with aerial images taken from the airplane over the landscape and fleets of aircraft. This perspective inspired him to draw *A Future Planits for Leningrad*: *The Pilot's Planits* in 1924 and *Design for an Airport,* which were influenced by the shape of an airplane seen from above.[247]

In the United States, early exhibition flyers of the 1910s, such as Arch Hoxsey, Ralph Johnstone, Blance Scott, Mathilda Moisant and Harriet Quimby, performed aerial stunts and competed in races. After the First World War ex-military aviators –the so-called

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[245] *Marinetti, Mazzoni & Somenzi 1997 (1934), 137-138.*

[246] *Wohl 1994, 182-194, 272-273, 276.*

[247] *Wohl 1994, 145-153, 161-177.*

barnstormers –used inexpensive war surplus airplanes to take people for short flights and perform stunts. Film studios in Hollywood also discovered aviation in the twenties and produced dozens of aviation films. Furthermore, by the twenties airplanes had become faster and more reliable, which opened an era of distance flights. A U.S. Navy plane crossed the Atlantic on May 29, 1919, and in May 1923 Lieutenants John A. Macready and Oakley G. Kelly completed the first non-stop cross-country flight across the United States. On his aerial tour of 1926, the most famous American aviator, Charles A. Lindbergh, and his airplane Spirit of St. Louis flew to 48 states and 82 towns to promote aviation, with the support of the Guggenheim Fund for Promotion of Aeronautics, and in 1927 he made the first solo, non-stop flight from New York to Paris.[248]

Expectations concerning aviation were often utopian and the new technology was expected to change human affairs in a profound manner. The air age was to bring peace and harmony and foster a great future of democracy, equality, and freedom. Aviation was to prevent wars and abolish frontiers as airplanes would eliminate borders and render physical objects such as mountains and oceans meaningless. These were very modern hopes. In the American context Joseph Corn has even called this phenomenon the winged gospel, an extension of evangelical Protestantism. In his view Americans associated the aircraft with a technological utopia and believed that machines were agents of progress. They believed that secular, industrial development was evidence of religious progress and impregnated machinery with spiritual implications.[249] The aircraft had enormous symbolic value that surpassed its functionality as a modern machine.

It is then important to differentiate between "the machine" and the typical machines and technologies present in the first half of the twentieth century such as the locomotive, the automobile, the ocean liner, and the aircraft –or the Flying Machine as the Wright brothers called it. These machines of transportation were invented in a cultural context characterized by the use of heavy machinery in manufacturing facilities and the construction industry. Furthermore, societies were mobilized and reorganized by the forces and actors that could be viewed as the "machinery of modernization." "The machine" was then the symbolic dimension of the machine defined as a technical artifact utilized by engineers and workers in factories, drivers on motorways and aviators on airfields. It was "the machine," not the machines that inspired Banham to call the era born out of the processes of industrialization, mechanization and modernization "the machine age."

While aviation inspired various modernists, the Futurists were the most enthusiastic. In Banham's opinion the significance of the Futurists was in their ideological impact; in transmitting formal and technical ideas, not all of which were of Futurist origin. Banham argued that unlike many other modern art movements, Futurism was profoundly reoriented toward a new world changed by technology. While it is obvious that the

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[248] *New York restaurant owner Raymond Orteig offered a prize to the first person to cross this distance in 1919. After the offer expired with no try-outs, he granted another 5-year period for the reward. Lindbergh flying solo (with a one-engine plane and no radio to decrease weight and drag and increase speed and fuel efficiency) was the first one to succeed in the 33.5-hour flight. Corn 1983, 9-14, 17-19, 22.*

[249] *Corn 1983, 34-38, 44-47.*

emphasis he placed on the Futurists left other modernists in the shadows, according to Banham they were especially important for the modern movement because their revolutionary spirit embraced the whole of society, not just the arts.[250] Marinetti introduced ideas that became crucial concepts in the modern movement. These included the opposition to handcraft, the idea that democratic architecture was not monumental, and the emphasis placed on the power station as the apotheosis of technology. He contrasted classical architecture with engineering products, saw buildings as equipment, and identified the three major building types of modernism as the low-cost housing assembly, the modern villa and the assembly hall. After the Second World War this list was widened to include new building types associated with the postwar modern lifestyle of automobiles, airplanes and consumer goods –the airport, the garage and the shopping mall.[251] These building types were developed from previous models for mass assembly buildings such as the railway station, the shopping arcade, and the airship or airplane hangar. Hence, along with the corporate headquarter they are the postwar building types of modern architecture, and the second generation of truly modern buildings.

3.3. Air-Minded Architects

The machine aesthetics promoted by the Futurists and other modernists found their architectural expression in the writings and visions of the avant-garde architects. While the historians of the modern movement paid little attention to aircraft, architects were clearly air-minded. Aviators, aircraft and buildings for mass transit were well rooted in the visions of the avant-garde architects, but while aviation was discussed in the early writings of the architects, references to the aircraft disappeared as the modern movement evolved and its history was written. An analysis of the literary oeuvre of Le Corbusier and other architects reveals enthusiastic comments about the aircraft and the depiction of an array of utopian architectural plans, where modern skies are crowded with airplanes circling over urban landscapes.

Le Corbusier's visionary architecture is accompanied by an interesting set of stories about the air-minded architect. He was obsessed with the airplane, and included the aircraft in his revolutionary writing. In *Vers Une Architecture* (1923) he compared the spirit of the Parthenon with that of the aircraft and posed the problem of the house through that of the airplane. Le Corbusier writes: "The airplane is indubitably one of the products of the most intense selection in the range of modern industry. The War was an insatiable 'client' never satisfied, always demanding better. The orders were to succeed at all costs and death followed a mistake remorselessly. We may then affirm that the airplane mobilized invention, intelligence and daring: *imagination* and *cold reason*. It is the same spirit that built the Parthenon."[252]

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[250] *Banham 1980 (1960), 104, 107-108, 135.*

[251] *Banham 1980 (1960), 123; Bosma 1996, 52; Brawne 1962, 341.*

[252] *Le Corbusier 1986 (1923), 109.*

The aircraft became a war machine during the First World War. Famed aces, the French Roland Garros and Georges Guynemer, and the Germans Oswald Boelcke, Max Immelmann, and the Red Baron Manfred von Richthofen, were glorified as modern knights fighting in the air with an aircraft and a machinegun. Stakes were high and therefore innovation was frequent. Most aces were sportsmen, who had competed in modern athletics like cycling, car racing and tennis before their military education. The first of these sportsmen to become an ace was Roland Garros, who in 1915 experimented with a pilot-operated machinegun and succeeded in firing along the axis of the plane. At the beginning of the war, the French dominated the skies, and were able to photograph the German lines, direct the fire of their batteries, and conduct bombing raids. Germans responded by developing their own fighter plane, and after Garros' airplane was shut down and captured the Germans perfected its design into the Fokker E. Subsequently, especially Richthofen contributed into the development of not only the aircraft but also the technique of attacks in the air.[253]

Aerial photography was also developed during the First World War. It was quite natural to combine the relatively new visual reproduction technique with the vantage point provided by the modern flying machine. Aerial photography had tremendous importance for warfare, as photographs, interpreted by specialists, documented the tactical moves of the enemy and provided information about war production and the location of strategic points such as bridges or factories. In October 1915 the German film technician, Oskar Messtner, invented a camera that could automatically take a sequence of photographs from the airplane. With this device it was possible to film a rectangular area of 37,28 x 1,55 miles in a single reconnaissance flight. Trained interpreters would read the flattened and cubistic images, and bombing was based on this information.[254] As Le Corbusier so poetically stated, the aircraft did in fact develop because of the insatiable war. Warfare perfected the aircraft and related technologies, which in turn inspired the imagination of the people.

In 1935 Le Corbusier published *Aircraft*, a book devoted solely to the wonders of flight. In this book he describes his first experience of an aircraft: "One night in the spring of 1909, from my student's garret on the Quai St. Michel I heard a noise which for the first time filled the entire sky of Paris. Until then men had been aware of one voice only from above –bellowing or thundering –the voice of the storm. I craned my neck out of the window to catch sight of this unknown messenger. The Comte de Lambert, having succeeded in 'taking off' at Juvisy, had descended towards Paris and circled the Eiffel Tower at a height of 300 meters. It was miraculous, it was mad! Our dreams then could turn into reality, however daring they might be."[255] In *Aircraft* Le Corbusier also described the breakdown of order in 1909 when (according to him) 300,000 people left Paris on trains to Juvisy, where Hubert Latham and other aviators had announced they would fly at 2pm. The crowd never made it there, and the young Le Corbusier, arriving at the train

[253] *Wohl 1994, 203-228.*

[254] *Wohl 1994, 285.*

[255] *Le Corbusier 1988 (1935), 6.*

station at 7pm, caused chaos by breaking everything breakable at the railway station –the symbol of the old, pre-modern world.[256]

These words are clear evidence of the avant-garde architect's enthusiastic attitude towards technology, and the promise of progress and future it seemed to embody. But the airplane had to undergo a similar developmental period like that of the bicycle and the automobile: a transitional period when wealthy amateurs used the new vehicles for excursions, sportsmen competed in races sponsored by newspapers, and inventors were looking for financial gain. Flying was more difficult and expensive than the other sports, but had wonderful potential that attracted people to the early airfields to follow races and witness the experiments. Teams of aviators traveled to various countries and cities to demonstrate their skills. The most famous and glamorous meets of the time were the Rheims meeting, organized by the investors of Compagnie Générale de l'Aerolocomotion in May 1909, and the Grande Semaine de l'Aviation de la Champagne in August 1909. Aviation was then clearly an upper class experience and part of the elitist lifestyle of the wealthy. It would take decades before the fleeting sensation of modernity, felt onboard of an aircraft became available for the masses.[257]

Despite the enthusiasm for aviation, few exchanged the regularity, safety and comfort of trains and ocean-liners for the shaky and dangerous experience of flying. In the 1910s flying was still a daredevil sport. Nevertheless, aviation was developing into a serious form of transportation that would collapse days of travel into hours.[258] As frequent and regular flying schedules were established, Le Corbusier flew to Moscow via Le Bourget, Cologne, and Berlin in 1928. In the description of his flight tour, he noticed how airports had developed into a cluster of hangars and other buildings. These building complexes formed air stations, which functioned with the exactitude of railway stations. Le Corbusier was impressed with the unexpected exactitude and professionalism of the service. Yet, he was critical of how airports were developing without a general plan, thought to spatial identity, or geographical location. While he did not propose a plan for an airport, he insightfully recognized that the building type had developed according to immediate needs and without overall architectural planning.[259] In light of these comments, it could be argued that architectural historians ignored early airports, as architects did not build them. However, as we will see in the following chapter, some of these airports were actually designed by architects, albeit not the known modernists, and it is true that most of them comprised of ad hoc buildings erected out of immediate need to protect aircraft and passengers.

Also other architects were among the first passengers aboard aircraft. Alvar Aalto flew for the first time in 1924 and frequently after that –for instance to France in 1928.[260] But it

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[256] *Le Corbusier 1988 (1935), 7. It must be said that in his enthusiasm Le Corbusier is an unreliable narrator. For instance, it is estimated that at Juvisy there were only 100,000 people, not 300,000.*

[257] *Wohl 1994, 99-110.*

[258] *Wohl 1994, 255, 258.*

[259] *Le Corbusier 1988 (1935), 10.*

[260] *Aalto described his trip to Denmark, Holland and France in* Sisä-Suomi, *August 18, 1928. Schildt 1985, 55.*

is again Le Corbusier, whose descriptions of his flights in South America, and especially the Amazon and Rio de Janeiro have become legendary. In *Precisions* (1930) he described the air view of cities, which clarified his impressions of how cities should be planned in relation to the surrounding natural landscapes of undulating seashores and rising mountains. These stories by Le Corbusier illustrate the reality of aviation and were published only after his earlier avant-garde visions for airports had proven to be absurd and unsafe. Nevertheless, they still demonstrate the technological optimism avant-garde architects attached to the aircraft. For these architects the airplane was a symbol of modernity, progress and the future. The aircraft would change the way the world was perceived and lead to new innovations. Dreams of new architecture and society might then well become reality.[261]

Le Corbusier utilized aerial images in his design practice and especially his topographical model for Algiers depended on aerial photography. In 1935 he claimed: "By means of the airplane we now have proof, recorded on the photographic plate, of the rightness of our desire to alter methods of architecture and town planning."[262] Other architects made similar connections. For instance, Joseph Hudnut recognized the future of modern suburban housing on a flight from Boston to New York, during which he saw an analogy between the automobiles arranged in herringbone patterns on parking lots and the uniform grid of prefabricated suburban houses amidst them.[263]

In *Four Routes* (1941), Le Corbusier continued to discuss different modes of transportation, including aviation, and he acknowledged how fast the aircraft had developed: "No exact prophecies can yet be made as to the forms that aviation will take. The most dazzling discoveries are in progress and some new technical invention might any day come along and change all our preconceptions." For Le Corbusier, the aircraft embodied the future: "The airplane is a distinguishing mark of the new age. At the summit of an immense pyramid of mechanical progress, it opens up an era: rushes into it on wings... To-day there lies before us a new machine age which must be brought into line with humane values. The aeroplane, in the sky, carries our hearts above the humdrum of daily living. The plane has given us a 'bird's eye' view. And when the eye sees clearly, the mind makes wise decisions."[264]

Interestingly, even when Le Corbusier, the Futurists, and other modernists wrote about the aircraft in their pioneering writings about the modern era and design, those who wrote the first histories of modern architecture, which emphasized other projects by the same architects, overlooked these references. One reason for this is that the early utopian plans were never realized. Furthermore, the airfields and aircraft were only features within overall visions for the future. When the canon of modern architecture was constructed, historians relied on actual buildings and emphasized certain aesthetic (stylistic) and functional qualities in order to support their argumentation.

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[261] *Le Corbusier 1991 (1930), 235, 241-242.*

[262] *Le Corbusier 1988 (1935), 11.*

[263] *Hudnut 1993 (1945), 71-76.*

[264] *Le Corbusier 1947 (1941), 104, 110.*

The modern vision, the new mode of perception, which was achieved through the view provided by technologies such as the camera, the x-ray machine and the aircraft, were only sparingly discussed in the histories. Yet it was precisely these new technologies with their claim for transparency and evidence that had the potential to expose the hidden structure underlying the modern society and reveal its inner contradictions, fragments, inequalities, transience and mobility that could provoke social and political change. While Marxist thinking, which exposed economic structures and advanced social and political reform and revolution, influenced architects like Ernst May,[265] neither the historians nor the architects (with the possible exception of Adolf Loos), explicitly discussed Freud's *On Dreams* (1901),[266] which similarly exposed previously hidden inner structures influencing human interaction. It could be argued that Freud's book represented the science of emotions and on some level interpreted the dream of modernization. This dream was that of progress and harmony, but in reality the processes of modernization fragmented the society and the individual, causing the modern condition to become that of fragmentation and crisis. Dreamwork then exposed the interface between the dreams of coherence inherent in modernization and the reality of the fragmented modern condition. In relation to architecture it posed the question whether architecture should expose rather than disguise contradictions between the dreams and the reality of modernization. Hence, what was common to the modern modes of perception was the scientific mindset that approached various aspects of the society and humanity in a logical and structural manner and advanced reform and emancipation. Even when the relationship between these ideas and utopian architectural plans is not explicitly stated, there are implicit analogies between the utopian architectural drawings and the new modern vision found in the discoveries made in the modern sciences, psychoanalysis and political thought.

3.4. Utopian Visions

Le Corbusier and Antonio Sant'Elia were the two modernists who were most enthusiastic about aircraft. Sant'Elia's central station drawings for *La Città Nuova* (1912-1914, fig 3.2.) and Le Corbusier's urban plan for *Une Ville Contemporaine* (1922) both included an unrealizable airport. These transportation hubs would have had railways and motorways running on different levels under the airfield. Le Corbusier and Sant'Elia were not the only ones envisioning traffic centers and airfields in utopian town plans, but in relation to airport architecture their visionary drawings are the most famous and the most often published. The utopian aspect of the aircraft found its architectural expression in the modern imagery of aerodromes and traffic centers among skyscrapers.

The Milanese architect, Antonio Sant'Elia (1888-1916) envisioned Futurist architecture in drawings he did between 1912 and 1914, and some of which were

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[265] *On May and Das Neue Frankfurt see Heynen 1999, 68-70.*

[266] *This book was the abridged version of* The Interpretation of Dreams*, published in 1900. Freud, who was Loos' Viennese contemporary (Freud lived in Vienna 1856-1939 and Loos 1870-1933), was influential for Loos's thinking on architecture, although this is not explicit. Freud 1990 (1901).*

exhibited in the 1914 *Nuove Tendenze* exhibition under the name *La Città Nuova*. These drawings along with “The Manifesto on Futurist Architecture” and his death in the war canonized him as the architect of the Futurist generation.[267] Sant’Elia designed different types of modern facilities such as power stations, hangars for airships, villas, apartment buildings and assembly halls. None of his designs were ever realized, but images of them circulated widely and were influential for the following generation of architects. Sant’Elia proposed that Milan’s Central Station would be rebuilt and the Viale Vittor Pisani covered with a platform providing a landing area for aircraft. This transportation hub, called *Stazione Aeroplani Treni* (1914), combined a metropolitan railway station with numerous highways circling under a rooftop airfield. The various levels of transportation were linked with elevators that took passengers from railroad tracks to the airfield. In Sant’Elia’s futurist visions aviation was an established form of transportation.[268]

The idea of vertically segregated traffic circulation was a frequent feature in early visions for the modern city. The central station’s deck in *La Città Nuova* serves as a landing area for aircraft quite the same way as in Le Corbusier’s *Une Ville Contemporaine*. Railways and highways running under the landing platform connected these traffic centers with other parts of the city. According to Banham this type of compact transportation infrastructure was not a revolutionary idea. He claims Sant’Elia was influenced by Gustav Kahn, who in turn, was familiar with Doctor Tony Moilin’s ideas to solve traffic problems in Paris by constructing streets on various levels with the underground and over ground railways converging at the central station.[269]

French planning ideals were greatly influenced by the Saint-Simonian movement, which envisioned development projects in enormous scale and claimed that these projects would promote social change.[270] Giant projects for energy and transportation systems such as the Suez and Panama canals seemed utopian at the time, but these and similar immense construction projects for canals, railroads, bridges, highways, dams, irrigation systems, hydroelectric power plants, nuclear reactors, new towns, and even space travel were actually realized later in the twentieth century. Segregated transportation levels circling under Paris were first proposed by the Beaux-Arts architect and metropolitan reformist Eugène Hénard (1849-1923) in his visionary urban plans for Paris (1903-1910). Jean-Louis Cohen has shown how Hénard’s plans influenced later planners, including Le Corbusier. Hénard paid attention to a combination of technology and architecture as a model for future aesthetics. This was an important precedent for Le Corbusier, who introduced the Farman “Goliath” aircraft as a source for new architecture in *Vers Une Architecture* ten years later. In Cohen's view Hénard’s *Ville de l’Avenir* (1903) prefigured the elements of many later utopian urban plans by Le Corbusier and other avant-garde architects. It combined technological sciences with architecture and thus abandoned the

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[267] *The Manifesto's earlier version* Messagio *appears to differ greatly from the manifesto and there has been a question about the authorship that is generally attributed to Sant’Elia and Marinetti. Banham 1980 (1960), 127-128; Sant’Elia & Marinetti 1990 (1914).*

[268] Antonio Sant’Elia. Gezeichnete Architektur *1992; Satoris 1993.*

[269] *Banham 1980 (1960), 132.*

[270] *See Picon 2002.*

reality of the city to imagine an ideal city without a specific location. Hénard already paid attention to the placement of modern services in apartment buildings, and emphasized the need for hygienic, well-light and ventilated apartments. His design for a city with airplanes flying over it foresaw the fascination for aviation that all the European avant-garde architects, Futurists and Constructivists alike, would share.

Hénard's studies on traffic circulation and his urban plans for Paris were especially influential for Le Corbusier's *Plan Voisin* (1925), which intended to reorganize the city structure of Paris. Hénard's ideas of a grand east-west opening through the city and elevated streets were repeated in Le Corbusier's plan. In *Ville de l'Avenir* Hénard already made a clear distinction between the residential quarter and the street for traffic as the two constituent parts of the city. Hénard's drawing for the future street has trams on street level, and separated levels of service and heavy traffic roads running underneath the street level. Airplanes land on the roof of his modern six-story apartment building and are subsequently lowered to an underground garage by escalators. These underground garages store private airplanes alongside automobiles that residents use to commute in the city. Hénard's plan is based on a transformation of an existing road in Paris, but it simultaneously proposes an ideal city in which the streets for automobiles, tramways, service roads, intercity traffic roads, and decks for loading merchandise are placed on separated levels (fig 3.3).[271]

The idea of vertical segregation is also proposed in Le Corbusier's plan for *Une Ville Contemporaine* (1922, fig. 3.4), which envisions an airfield between four towering skyscrapers. This contemporary city is laid out on an ideal site and consists of a geometrical plan of major and minor axis, intersections and orthogonal and diagonal roads. The core of the city is a business center, surrounded by residential areas, while industries are located on the outskirts of the city. The transportation hub is situated in the very center of the city and has railways and highways running under an airfield that occupies an elevated plaza. Le Corbusier's plan includes underground service roads with access to buildings, and intercity heavy traffic roads running across the city in tunnels. While connections between different modes of transportation are ideal in the vertical traffic hub placed in the very center of the city, landing amidst high-rises is an absurd idea when aviation safety is concerned. Therefore Le Corbusier's plan is an unrealizable vision for a modern airport.[272]

Writing in the 1920s, Le Corbusier acknowledged that the aircraft of the day could not perform well enough to use the airport he envisioned. Therefore his plan saw the central airport as a landing terrace for *aérotaxis*, which would shuttle from the center to a larger airport (*aérodromé*) on the outskirts of the city. But even when acknowledging the safety hazard, Le Corbusier insisted on a central airport thus prioritizing transfers between different modes of transportation and making the transit center the heart of the modern city. This idea of centrality was closely connected to the nineteenth century railway station, most often situated on the circle around the city core as in Paris and London or in

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[271] *Cohen 1982, XIV-XVI; Hénard 1982 (1903-1910), 345-349. See for instance Berman 1988, 72-74.*

[272] *Le Corbusier 1987 (1925), 187-192.*

the very center of the city as in Helsinki. At the time the railway station was the only existing model for organizing mass transportation.

"For the moment, the airport allowed for in the center is a rank for air-taxis connecting up with the aerodrome in the protected zone," claimed Le Corbusier, "Means of landing are not yet sufficiently perfect to allow the large transcontinental airplane to make its way safely to the heart of the city. Similarly, the problem of landing upon the roofs or terraces of dwellings remains equally unresolved. 'Domestic' aviation still seems to be some way off."[273] Le Corbusier was then waiting aviation technology to catch up with his design for an airport amongst skyscrapers. He waited for the day when the landing technique was developed enough and there would be private, domestic aviation. But the idea to land airplanes atop skyscrapers was clearly utopian, when in 1925 experts stipulated that runways should be 2,700 feet in length i.e. far larger than any building imaginable. In the following years technical changes such as streamlined all-metal construction, cowled engines, retractable landing gear and wing flaps increased rather than decreased runway requirements because takeoff and landing speeds increased.[274]

While Le Corbusier's visions were deemed utopian, he insisted on them. In the subsequent plan for *La Ville Radieuse* (1933) skyscrapers had "runway platforms available 25 meters wide by 150 to 100 meters in length," now practical because many of the problems involved in such landings had in Le Corbusier's view been solved in the development of the aircraft carrier. Yet the main airport was laid on flat land in an open area at the periphery of the skyscraper city. Farsightedly Le Corbusier was well aware of the problems related to this location and warned that long travel time to an airport outside the city would cancel out the advantages of travel by air. He thus foresaw the problems that would later face actual airports in exurban locations.[275]

Though Le Corbusier's plans may be fairly criticized for being overly optimistic about the development of the aircraft and aviation industry, Banham blamed them for not being bold enough. In *Theory and Design in the First Machine Age*, he published an image of the traffic center in *Une Ville Contemporaine* as an example of "the Futurist dream of multi-level circulation and towers, regularized in terms of Beaux-Arts geometry and German-style glass towers."[276] He then suggested that the Futurist spirit was tamed in Le Corbusier, whose urban plan was closer to Beaux-Arts geometry and rationalism. Partly this was a logical consequence of hénardian thinking, which was based on a rational combination of architecture, technological sciences and engineering, rather than feverish visions of a mobilized, technology driven world. For Le Corbusier "the lesson of the airplane is not primarily in the forms it has created... [but] in the logic which governed the enunciation of the problem and which led to its successful realization. When a problem is properly stated, in our epoch, it inevitably finds a solution."[277]

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[273] *Le Corbusier 1987 (1925), 189.*

[274] *Le Corbusier 1987 (1925), 189; Corn 1983, 106.*

[275] *Le Corbusier 1967 (1933), 277.*

[276] *Banham 1980 (1960), 237.*

[277] *Le Corbusier 1986 (1923), 110. Despite Banham's claim, Le Corbusier's towers actually precede the Friedrichstrasse competition.*

Le Corbusier saw aircraft design as a model of rational problem solving and planning. Yet, the laws of aerodynamics escaped him and other architects, who failed to understand how the skeleton, the stretched skin construction of the aircraft, and the ultimate use of materials were constituent elements of the aircraft's performance. The prewar flying machines were fragile constructions made out of thin wood and bamboo, bind together with piano wire, and clothed in linen cloth. These machines resembled products of artisans rather than the creations of advanced industrial technology. The early all-metal aircraft were similarly fragile skeleton and stretched skin constructions, where the skeleton, the materials, and every component had a functional role in their performance. Nothing could be added or subtracted without affecting the delicate balance of the aircraft. Aesthetically modern architecture resembled the early aircraft –and especially the Farman F.60 Goliath celebrated by Le Corbusier (fig. 3.5.) –but this resemblance was lost when the machines advanced and architecture ceased to express the *Zeitgeist* associated with them.[278]

Le Corbusier revised his views on airport design towards the end of the 1940s. In the first postwar French Congress of Aviation in 1945, he promoted the idea of a "naked" airport situated in the open country outside the city center. Buildings at this airport were not to be taller than 8,5 feet so that they would not destroy the "biology of modern airplanes." In his view, once one had landed in an airplane, any architecture in view would be inferior to the magnificent airplane and the harmony of its form. Therefore an airport should be naked, and only comprise sky, grass, and a concrete runway. A stonewall, decorated with flowers, would be the only vertical architectural element. Facilities for reception, customs and other functions were to be located behind this wall on a basement level. The scale of the airport would repeat the minutely human scale inside the aircraft cabin. Le Corbusier strongly condemned the academic style and scale of grand railway stations because of their nostalgia, and demoralizing effect. He wished the future airport to approach his concept of the naked airport and concluded: "The beauty of an airport is in the splendor of wide open spaces!"[279]

Other avant-garde architects also proposed airfields and sketched airports for their visionary plans. Erich Mendelsohn's (1887-1953) expressive sketches for a modern air terminal, envisioned during the First World War, added glamour and the image of streamlined speed to the new building type. He aimed to catch the movement of the new machinery in an architectural imagery that was reminiscent of Futurist long-exposure photographs of moving lights. Mendelsohn's aerodrome of 1914, *Skizze für einen Flughafen für Luftshiffe und Aeroplane,* was a cast concrete and steel frame building, which had a tall central hall for airships and two lower wings for airplane hangars and workshops. The streamlined quality and the enormous size of this building (1,300 feet long) influenced many later terminal designs.[280]

Though rarely mentioned in the histories of aviation, the French proposed several more realistic airfields or *aérodromes* in the 1910s. Beaux-Arts urban designers Donat-Alfred Agache and Ernest Hébnard designed the earliest municipal airfield plans. Agache's third-

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[278] *Banham 1980 (1960), 328-329; Wohl 1994, 261.*

[279] *Le Corbusier 1946, 198-199.*

[280] *Eckardt 1960, 13; Mendelsohn 1930.*

prize entry in the competition for the new federal capital of Australia (1912) and Hébnard's plan for the International World Center (1913), done in collaboration with the Danish sculptor Hendrik C. Andersen, both included an airfield outside the city center. Agache's plan organized administrative buildings and hangars symmetrically around a rectangular airfield, the size of which was actually more suitable for parades than air operations. Hébnard & Andersen's hexagonal *port avion* had buildings on one side of the airfield, which was conceived as an integral part of the future metropolis.[281]

The city architect of Lyon Tony Garnier (1869-1948) proposed his social utopia called *Une Cité Industrielle* in 1917. This included an airfield at its periphery. Located next to a test track for automobiles and an industrial zone with a factory for airplanes, his half-mile-long airfield had hangars for airplanes and airships. The elimination of spectator stands, and the location near the factory indicates that this airfield was meant for testing the airplanes produced in the factory, not for air shows. This was a very realistic aeronautical plan for an industrial city of the future, where airplane manufacturing was one of the major industries. It is interesting to notice that Garnier anticipated mass production of aircraft and a need for an airfield. Yet, the emphasis of this and other early utopian urban plans was not on the aircraft but on the automobile and the railroads as the more imaginable forms of mass transportation.[282]

Frank Lloyd Wright planned airports to connect units in the utopian landscape of his *Broadacre City*, begun in the 1930s (fig. 3.6). In his vision people would commute in *aerogyros* or aerators that were able to rise straight up and had reversible rotors. However, as Hugh Pearman points out, the aerators Wright envisioned would have been totally dysfunctional if actually built. They would have rotated in circles and the round design would have resulted in an unbalanced flying performance. But this was of minor importance, since Wright was dreaming of an egalitarian agricultural society with low-rise houses, gardens and small aerators that everyone could operate and park anywhere within the city structure. Communal airports were not even needed except for commutes over longer distance beyond the aerators range. Wright's design was then clearly utopian, although the houses included in the plans strangely were not.[283]

In this regard Wright's vision corresponds with Joseph Corn's description of the winged gospel, a belief in the airplane as part of the immediate future for the air-minded. Part of this gospel was a belief that in the future every suburban garage would house an airplane. The aerial rural lifestyle envisioned a countryside from which people could commute to cities and workplaces. When Henry Ford started the production of aircraft, with his Tri-motor in 1925, it was thought that the price of the airplane would be lowered as significantly, as when he had introduced the assembly line produced Model T automobile in 1908. Indeed, by the thirties airplanes were less expensive, more convenient and safer to operate, and thus it seemed more realistic to realize the dream of an aerial

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[281] *Voigt 1996, 29; see also Andersen & Hébnard 1913; Bruant 1994, 154; Zanten 1987, 321, 332-333.*

[282] *Garnier 1989 (1917).*

[283] *Wright's decentralist vision of society was developed first in the 1930s and further elaborated during the postwar period in* When Democracy Builds *(Chicago: University of Chicago Press, 1945) and* The Living City *(New York: Horizon Press, 1958). Wright 1935.*

agricultural society. However, after several difficulties Ford withdrew from the production of aircraft in 1933. In the end only 199 Ford Tri-motors were produced, but the cost of an airplane had dropped from $7000 in the 1910s to $1935 in 1937. Nevertheless, the dream of an airplane in every garage was clearly not realizable; in 1937 there were 3000 registered airplanes compared to 25 million automobiles in the United States. Attempts to produce a safer and more maneuverable aerator resulted in the introduction of an autogiro, the precursor of the helicopter in 1923, but the aircraft never became a commodity in the suburban America.[284]

Visions of airports were part of the future city that was envisioned as a transportation node, and also part of the idea of a dispersed city of settlements connected by air routes. Neither of these visions was realized, but they maintained a central position in the formation of airport architecture. They represented "the machine age" the historians of the modern movement were promoting. Visionary airports were related to overestimated expectations, well illustrated by Norman Bel Geddes' claim: "We can expect the old 5:15 to be a group of ten passengers planes arriving at minute intervals" and extending "commuting distance from forty miles to hundred or hundred and fifty miles, or more."[285] Another illustration of these expectations is a story Le Corbusier tells of August Perret, who in July 25, 1909, right after Louis Blériot had crossed the English channel, claimed enthusiastically: "Blériot has crossed the channel. Wars are finished: no more wars are possible! There are no longer frontiers!"[286] Unfortunately this was a vision proved wrong very soon, at the beginning of the century of flight.

Interestingly, visionary thinking did not disappear from airport planning, but persisted alongside the realized airport architecture throughout the 1930s. Apparently, the dreams that flight seemed to embody were stronger than reality. This is clearly demonstrated by some of the entries in the American airport design competition organized by the Lehigh Portland Cement Company in 1930. This competition was looking for practical and permanent solutions in airport design. In the view of the competition jury, good precedents for airport design could not be found, and even the more established European airports were constantly rebuilt to expand and correct design flaws. The competition received 257

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[284] *Engineers developed the idea of a safe and easily maneuverable aircraft further. Fred Weick worked to lower the tailspin of the aircraft and developed an aircraft with a spin-proof design, tricycle landing gear and a two-control system. The aircraft at the time had a three control system: the pilot would operate a control stick (steering wheel) and a pair of foot pedals, all of which would be used independently to govern the plane's movement in the air. Pushing the stick would make the plane descend, pulling it would make the plane climb, and turning it would make the plane roll to the side. Foot pedal connected to the rudder would make the plane's nose move right or left and turn the aircraft. The system was hard to maneuver for a beginner, because turning and pushing or pulling the control at the same time would cause the plane to gain or lose altitude, while too much rudder would cause the plane to skid rather than turn. The two-control system sounded promising and fool proofed but in reality caused the pilot to have lesser control over flying and created dangerous situations. Corn 1983, 91-107; Pearman 2004, 78-80.*

[285] *Geddes 1932, 80.*

[286] *Le Corbusier 1988 (1935), 7. Le Corbusier's views find a precedent in the Saint-Simonian vision of transport.*

entries, which were evaluated for their aeronautical ideas, new architectural conceptions, engineering features, and influence on city planning. New aeronautical ideas included taxiways and parallel runways to increase efficiency and operational safety. Terminal buildings were proposed to be as permanent, reliable and dignified as the old railroad terminals. Engineering features such as underground rapid transit systems, cantilevered structures for loading areas, and hard-paved surfaces for taxiways, runways and the apron were proposed to improve the infrastructure of the airport. Efficient highway connections and recreational use of the area surrounding the airport were also suggested. While many of the entries were classical in style and featured Versailles-inspired runway layouts, within a circular overall form, some entries envisioned utopian solutions. For instance, H. Altwater's airport for New York featured a huge wheel of runways resting on skyscraper roofs. Airplanes were to takeoff on runways that ran across the wheel.[287]

Other visions for landing platforms atop skyscrapers were proposed for various cities, including London, Hamburg, Milan and Leipzig between 1928 and 1935. A unique proposal of the 1930s was André Lurçat's project for an airport on the River Seine in Paris. In 1932 he proposed a platform with a catapult system that would launch the airplanes as was done on aircraft carriers. Hangars and garages were then placed on a lower level, below the deck.[288] Writing in 1932 aviation specialist Angley H. Lewis-Dale surprisingly evaluated the development of takeoff catapult systems and other special aircraft development reasonable. However, he did not consider that various airfield schemes atop railway stations rivaled the established form of independent aerodrome, and criticized these plans for being impractical at the present stage of aviation.[289] Yet, the idea persisted and a rooftop landing area for helicopters atop a skyscraper was later realized in the Pan Am Building (1958-1963) designed by Walter Gropius and Architects Collaborative. However, these later plans do not have any social content. Rather they are just futurist imagery that has to do with visions about the development of communication and travel. Technology in them is no longer a vehicle for social progress.

After the Second World War, uncritical enthusiasm about aviation changed into a more realistic, ambivalent and anxious view of its technologies. The aircraft was now seen as a weapon and a political tool in a world that was ideologically divided and threatened by nuclear annihilation. The Soviet blockade of Berlin in 1947, the India-Pakistan war in 1948, the 1949 communist takeover of China, and the Korean War in the fifties diminished the hopes for a happy air age. The airplane had become an established form of

[287] *The Lehigh Airport competition had a jury comprising of architects, engineers, city planners and experts in aeronautics. The program asked for a modest but complete midsize airfield for general aviation. It was to have paved runways and a functional terminal building. Minimum of four 100 feet wide runways was required in order to provide safe landing and takeoff into the wind in each of the eight cardinal and quarter points of the compass. Terminal building was to have complete facilities for the public, the transportation companies and the pilots, customs and immigration, and complete traffic control facilities. Other buildings included hangars, a repair service station, a hotel, and concessions.* American Airport Design *1990 (1930), 10-12, 49.*

[288] *Lurçat 1932, 86-89.*

[289] *Lewis-Dale 1932, 106-108.*

transportation and a powerful tool in the defense system. During the Cold War it was obvious that the air age would not be one of harmony and peace. Once heralded as the most significant mechanical innovation of the century, the airplane ceased to symbolize future of unlimited mobility, world peace, greater democracy and equality.[290]

Some of this enthusiasm shifted from aviation to space flight. During the Cold War the United States and the Soviet Union were engaged in the space race (1955-1972), a competition for supremacy in spaceflight capability. Rocket technology had already been experimented with during the war, but now more funds were channeled into the development of rocketry, missiles, satellite technology and space flight. At first, the Russians led the race with such milestones as the first satellite (Sputnik 1, 1957), and the first human spaceflight (Maj. Yuri Gagarin aboard Vostok 1 on April 12, 1961). In the context of such Cold War events as the Suez Crisis (1956), the Berlin Crisis (1961), and especially the Cuban Missile Crisis (1962), the space race had a deeper ideological significance. The Americans selected an achievable goal within a reasonable timeframe and on May 25, 1961 President Kennedy announced a program to land man on the moon by 1970. Thereafter the Americans accelerated their progress with successful Mercury missions (1961-1963), and multi-crew Gemini missions (1965-1966) experimenting with rendezvous, docking techniques, and space walk. The Russians were accomplishing similar experiments in Vostok (1961-63), Voskhod (1964-66), and Soyuz (1966-) programs, but it was the American Apollo-Saturn program (1961-1972), which culminated in the Apollo 11 mission, the first manned lunar excursion and the landing of astronauts Neil Armstrong and Buzz Aldrin on the moon on July 20, 1969. Six such lunar flights were accomplished before 1972, and eventually the space race ended symbolically during the détente, when Apollo and Soyuz docked in space on July 17, 1975. These were not small accomplishments, considering that man had flown for the first time only fifty-eight years before space flight began. However, technology was no longer seen as purely beneficial or even neutral, and the responses to the moon mission were diverse. Furthermore this event was broadcast through the medium of the television, and the experience was therefore less direct and emotional than the one on early airfields.[291]

The utopian dimension was not present in postwar airport planning. Instead, the airport terminal evolved as a modern building type in response to complicated and real design problems, and the discussion about the airport focused on the infrastructure for aviation. There was a clear transition from the futurist realm to the real. Even when some elements of flight were included in the paper architecture of the 1960s, such as Archigram's *Instant City* (1968-71), where inflatable structures were to be transported to the site by an airship, these plans were based neither on reality nor on futurist visions of aviation. Rather, the whole city was in motion and people were nomads plugging into temporary living environments. Arguably, however, the airplane would have offered a more suitable vehicle for these nomads than the automobile discussed in *Archigram 8*.[292]

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[290] *Corn 1983, 65, 132, 138-139.*

[291] *Bilstein 1984, 205-217, 267-280; Corn 1983, 145.*

[292] *Archigram, a group formed by Peter Cook, Dennis Crompton, David Green, Ron Herron, and Michael Webb, published between 1961 and 1974 nine issues of telegram like comics, which promoted new*

Simultaneously the megastructuralists such as Superstudio were envisioning extendable matrixes of modular units that could be built without limit and into which smaller units could be added periodically. These futurist urban structures formed networks of traffic channels, housing, and workplaces and found their inspiration in technology understood as a visually wild collection of piping, wiring, platforms, and landing-pads. This kind of imagery was readily available in space satellites, underwater laboratories, ocean fortifications, submarines, offshore oilrigs, oil refineries and ordinary industrial zones. While many of the megastructuralist projects remained in the realm of paper architecture, some such as Moshe Safdie's *Habitat* were constructed at the Montreal world's fair, Expo 1967. Banham argues that some megastructure ideas were also realized in American airports of the late-sixties, such as the Dallas-Fort Worth Airport (1965-73) by Hellmuth-Obata-Kassabaum, which is an exceptionally visionary plan for a modern airport. Its grand scale and structural clarity were based on massive terminal loops connected by railways and expressways, and as such it provided an example for later airport cities.[293]

Strictly speaking even the most visionary airport and airfield plans were not utopian as they did not propose an alternative and perfected social system. The lack of social or ideological content reduced their utopian dimension to futurist imagery or architectural adventurism.[294] However, the modern belief in technological advance, progress and emancipation associated the new means of transportation and the new ideals of town planning with progress that would be beneficial for all in an uncomplicated manner. This belief did not necessarily contrast the existing reality with an alternative perfected society, but implied that the progress associated with new technologies meant also social progress. This sort of a modern ethos was implicit in all airfield plans that were oriented toward future and embraced technology even if their politics were somewhat ambiguous or non-existing. They were political within architecture practice and promoted new aesthetics, but only some aimed for reform or made a negative critique of the existing society. Avant-garde rather than utopian, they nevertheless incorporated some utopian elements, which were stronger in projects where airport was a feature in an overall urban plan.

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urban ideas for the space age and criticized current architectural practice. The topics ranged from expendability and consumerism to space comics and megastructures and projects included Living City *(1963), Cook's* Plug-in City *(1964-1966) and Webb's* Instant City *(1968-71).* Walking City *(Ron Herron and Brian Harvey, 1963) comprised of a number of master vehicle units, which contained urban areas and residential districts. These controlled microclimates were linked to each other by retractable corridors and grouped into changing, mobile and flexible installations in the landscape. In the Archigram vision for future cities, movable units would be connected to a mechanical core of the city, the city could be instantly inflated out of bubbles structures hosting events, or the whole city would walk into new location. The ultimate vision was then the space-city. In this sense aviation had become an everyday form of transportation and the realm of dreams had moved into space.* A Guide to Archigram 1961-1974 *1994, 178-179, 218, 246-248;* Concerning Archigram *2002; Cook 1993 (1964), 366-369. Banham 1976, 84-98.*

[293] *Banham 1976, 8, 22-29.*

[294] *Colin Rowe has argued that social utopianism became confused with architectural adventurism in the 1920s. Banham 1976, 80.*

Even the avant-garde dimension of the airport is questionable because of the lack of political content. The airport terminal was an emerging, novel building type that allowed only marginal possibilities for criticism or an avant-garde approach. As a novelty this building type was clearly oriented toward the future, and architects who envisioned airports were definitely aesthetically progressive in their vision of a future that would be characterized by air transit. But they were preoccupied with finding a proper form and functional layout of the airport or a larger urban entity, and only some were seeking to alter the society. Rather, aviation and the emerging building type of an airport terminal offered architects material for visionary futuristic imagery.

Airports could also be seen as heterotopias in the sense that Michel Foucault has suggested ships are heterotopias. He defines them as sites, where other real sites are simultaneously represented, contested and inverted. What characterizes heterotopias is the juxtaposition, in a single real place, of different spaces and locations that are otherwise incompatible with each other. Furthermore, heterotopias are linked to time and function when traditional time is breached. Entered through rites or gestures, one is always excluded from their true hearts. Hence, heterotopias reveal the illusory quality of space, but simultaneously compensate for that illusion with a perfect, meticulous and well-arranged real space.[295]

In the case of the airport, rituals and procedures limit access to the airport, and allow passengers to enter the airport and proceed to an aircraft through limited zones and repeated security check-ups. The airport as heterotopia is a non-place that is connected to other similar non-places through a network of airways. The contemporary airport has a special quality of the unreal as a mixture of different nationalities and cultures, global retail and restaurant chains, air-conditioned interiors and universal signs, rituals and services, and the loss of time in changing time zones and on overnight flights. Every airport is the same and yet different. They are non-places only marginally affected by the respective geographical location. Entering the aircraft means transferring from one heterotopia to yet another that is possibly even more unreal, a more condensed mixture of nationalities and cultures, global aircraft meals and services, flight attendants and passengers lost in time zones without a specific geographical location above the clouds. It is a place that flies, a place without a place, a closed entity en route from one airport to another, and tied to dreams and imagination the way ships are.

It is not surprising that the aircraft and the airport intrigued the modernists and the avant-garde architects searching for a new urban vision of high-rise cities connected by effective traffic routes. The vertical dimension uniting skyscrapers and airplanes made them inseparable in the minds of early modernists. The verticality inherent in both soared to higher altitudes, higher spheres of dreams and visionary thinking. The imagery of early aviation was further elaborated in science fiction and movies, comic books and romantic literature.[296] Paradoxically, the aircraft was the most modern machine, and yet the machine aesthetics of this era were inspired more by the automobile, the locomotive and the cruise liner than the airplane. The aircraft remained an element in utopian visions for

[295] *Foucault 1986 (1984), 22-27.*

[296] *Pearman 2004, 86-89, see also Corn 1983; Pascoe 2001, 153-196.*

the city of the future, but the airport did not. Yet, what could be closer to the realization of Giedion's characterization of modern architecture as the embodiment of the novel space-time concept than the modern airport?

In what Reyner Banham called "the first machine age," it seemed that the aircraft was still a machine of the future. At the heyday of the air-minded, architecture that claimed to build *machines á habiter*, looked at the automobile rather than the airplane. It seemed that the aircraft belonged to the utopian realm envisioned in urban plans, while the airport was not yet modern reality. Modern architecture was inspired more by the aesthetics of the aircraft than its functional structure or innovative use of materials. The laws of aerodynamics, on which the skeleton construction of the aircraft was based, escaped the architects fascinated by the vision of the future embodied in the aircraft. In reality the early aircraft landed on crass fields and operations were run from a hangar placed in the proximity of the runway. Aviation was still an activity for adventurous aviators, and a spectacle for the masses that would gather at the early aerodromes to watch air shows of stunts and speed races. The machine that was available for most was still the Model T automobile, produced at the Ford factory assembly line, not the aircraft.

Of the visionary plans discussed above, only Le Corbusier's and Sant'Elia's are mentioned in the seminal histories of modern architecture. Others were left unnoticed. They form gaps and silences in the narrative of modern architecture. Thus airport architecture emerges out of the void in the histories of modern architecture and out of the clues and the evidence found in alternative historical documentation. Intriguingly, once the airport terminal was acknowledged as a modern building type in the sixties, the heralded postwar airports seem to emerge from a void, without any precedents in architecture. There is a long, silent history between the early utopian visions of the 1910s and the 1920s, and the realized airport architecture of the postwar period. This history is investigated in the following chapter.

4. The Typological Instability of the Airport Terminal

Airports progressed from simple aviation infrastructure to a modern building type in parallel with the institutionalization of modern architecture. This simultaneity partly explains the absence of the airport terminal in the historiography of modern architecture. First, not many airports existed at the time when the histories of modern architecture were created and second, for various reasons that will be explored here, the airport terminal did not meet the criteria for canonization. But when one examines the actual terminal buildings it is not obvious why the airport terminal was excluded. This chapter discusses the history of the airport terminal and describes the techno-social processes shaping its typology.

Throughout its development, utopian modernist visions and aviation's more prosaic imagery, everyday transportation infrastructure and progressive technologies, stylistic debates, and technical and logistical problems influenced the typology of the airport terminal. Techno-social processes such as the changing logistics of air travel, different sizes of propeller planes and jets, the construction and orientation of runways, and the airport's urban location shaped the form and function of the terminal. In the course of the twentieth century the airport and its terminal building took various distinctive forms, which are classified as aerodromes, airfields, air stations, and airports. This typological development –the establishment of a clear vocabulary of forms, which enables one to distinguish an airport terminal from other buildings –is often described in generations, which albeit being problematic in evoking the image of evolution, is nevertheless a useful way to describe how the airport terminal emerged as a modern building type.

Tracing the typological development of the airport terminal is not uncomplicated as the information is scattered across a wide range of literature. However, period design manuals, especially John Walter Wood's *Airports: Some Elements of Design and Future Development*, published in 1940, and H. Angley Lewis-Dales' *Aviation and Aerodrome: A Treatise on the Problems of Aviation in Relation to the Design and Construction of Aerodromes*, published in 1932, describe and criticize period airports from the planner's point of view and thus form the history of early airport architecture.[297] They are complemented by design manuals published in the fifties such as Civil Aviation Agency's *Airport Terminal Buildings* (1953), and typology studies in architectural magazines such as *Progressive Architecture*.[298]

A typological study of the airport terminal distinguishes the criteria of a functional airport from the criteria of modern architecture. The criteria for airport architecture is defined by function and emphasize flexibility and expansibility, maximum operational efficiency and functional spatial organization of the airport, technologically progressive runway and apron layout, compatibility with different types of aircraft, innovative engineering, and advanced construction techniques. Stylistic considerations are secondary. In contrast, the canonization of modern architecture is based on stylistic criteria such as

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[297] *Lewis-Dale 1932; Wood 1940.*

[298] Airport Terminal Buildings 1953*; Twentieth Century Building Type: Airport Terminal Buildings 1953.*

form, modern construction techniques and materials, innovative structure, aesthetics, and the dating of the building in relation to evolution of architectural styles. However, the criteria of a functional modern airport and those of modern architecture are not incompatible. Airport terminals that were not only technologically advanced, but also stylistically modern were built in the United States and Europe in the thirties. These include Adolf Benš' Prague-Ruzyny Airport (1933-1937), Paul Hedquist's Stockholm-Bromma Airport (1935-36), Vilhelm Lauritzen's Copenhagen-Kastrup Airport (1936-39), and Dag Englund and V. Rosendahl's Helsinki-Malmi Airport (1938). In addition streamlined terminals such as Holden, Stott and Hutchinson's Washington-Hoover airport (1930) were constructed in the United States. These airports then suggest a canon of exceedingly modern airport architecture, albeit its formation avoids any linear structure or completeness.

The typological instability of the airport terminal is what makes it such an interesting case in the history of modern architecture. The airport terminal could have developed along a number of alternative development trajectories, which are still visible in its history. These alternative development patterns expose the arbitrariness of typology as a classificatory device. Indeed, there never was a single airport terminal type that existed from the beginning. Rather, typology was utilized to identify the airport terminal building type and follow its evolution along an imaginary development trajectory, which became visible only once the building type was stabilized. Hence, typology enabled the evaluation of individual buildings according to a set of criteria defining the program, functionality, organization, form and aesthetics of the terminal. The typological instability of the airport terminal resulted from its changing technical requirements and undefined symbolic function.

It is of importance to view the airport as a piece of transportation infrastructure defined by a set of utilitarian and technological requirements, and separate it from the terminal building, which has to meet an additional set of aesthetic and symbolic architectural criteria. Hence, in this study the airport as infrastructure is distinguished from the airport terminal as an emergent building type and a specific node in the networks of transportation. Furthermore, the airport is defined as a large technological system, which consists of subsystems guided by its inner logic.[299] My aim in this chapter is to place Saarinen's airport terminals in the history of the airport, which is not included in the history of modern architecture and view the interfaces between the two narratives. Typologically the TWA Terminal is a decentralized satellite terminal, Dulles International a centralized gate arrival terminal and Athens International a centralized open finger terminal. These terminals formulated different solutions to the design problem of the airport terminal and were defined by their specific geographical and symbolic location. Furthermore, each of them found precedents in the history of the building type.

In this chapter I trace airport terminal's typological evolution between 1909 and 1969. This period begins with the pioneering aerodromes built for the flying events of 1909 and ends with the flight of the supersonic Concorde in 1969, which was also the year of the first lunar expedition, and the completion year of my third case study, the Athens Airport.

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[299] *For a definition of a large technological system see subchapter 2.2.2 of this study.*

In 1969 the next generation of airport terminals built for supersonic flight –the revolutionary Terminal 1 at Charles de Gaulle airport (often called Roissy 1) –was also well under construction. 1969 is also the end of the immediate postwar period, which Joan Ockman has defined as culminating in the political uprisings of the year 1968 and the paradigm shift to postmodernism. This timeframe conveniently lends itself for a subdivision of airport terminals into the pioneering aerodromes and air stations, terminals of the thirties, and postwar airport terminals.

4.1. Aerodromes and Air Stations

The story of the airport begins at Kitty Hawk, where Wilbur and Orville Wright experimented with their Flyer in 1903 (fig. 4.1). However, this isolated field was more a laboratory for experiments than a proper airfield as it was used only to test and improve the flying machine. The Wright brothers' second airfield at Huffman Prairie near Dayton, Ohio, was completed in 1904. It had a hangar for the flying machine, and also served as a venue for public flights and a facility to train pilots. These and other prewar airfields provided the minimal infrastructure needed for experimental flight and barely met the requirements for takeoffs and landings. They had a flat grass landing strip and a wooden hangar to protect the delicate flying machines from weather.[300] In what follows, I will discuss how these early airfields gradually developed into a recognizable structure of a runway, hangar and passenger terminal at the so-called "first and second-generation" airports.

The first purpose-built aerodromes were constructed for the major flying events of 1909. Rather than airports they were entertainment facilities, reminiscent of fair grounds. Rectangular or oval in shape, they had a spectator stand and catering facilities on one side, wooden hangars and workshops on the other. The middle ground was used for takeoffs, landings, and stunts during air shows. These early airfields were called *ports avion*, airdromes or aerodromes (in Greek aero=air, dromos=race or course). This terminology was derived from other racing fields such as autodromes for car events and velodromes for bicycle races. They were used as racing tracks for record-breaking aviation competitions and spectacular flying events, but provided only temporary facilities for airplane maintenance or spectator comfort. The most famous aerodromes were Port-Avion at Juvisy (1908) 15 miles south of Paris, the Reims aerodrome for le Grand Semaine de l'Aviation de la Champagne (1909, fig. 4.2), and the aerodrome for the International Flugwoche in Johannestahl in Berlin (1909). After Louis Blériot's famous crossing of the English Channel in July 1909 such air meetings were organized frequently and up to

[300] Lightweight planes were constructed out of wood, cloth and wire and were not durable enough to withstand winter storms or even strong winds. The word hangar derives from French and means a wide hayshed with one open side. I will not discuss hangar architecture in this study apart from a few noticeable examples. For more on hangars see Voigt 1996, 36-38.

100,000 modernists, artists, society celebrities, and other interested public gathered to witness flight on these aerodromes.[301]

Aircraft production increased significantly during the First World War (1914-1918). Several manufacturing plants were built for the war effort including the airplane workshop in Hanover (1915) and the AEG Airplane Factory in Henningsdorf near Berlin (1915), both designed by Peter Behrens. This well-acknowledged pioneer of the modern movement was involved in planning early aviation-related facilities.[302] Simultaneously with the manufacturing plants, a network of military airfields blossomed across Europe, but they could hardly be classified as architecture. These provisional airfields were elliptical grassy areas, which had a maximum diameter of at least 1500 feet and a slightly downward incline from the center to the edge. This arrangement allowed takeoff even against the wind. The barracks and hangars on the edges were most often tents.

Civilian air transportation began as an army-surplus operation after the First World War. However, regular Zeppelin flights had been organized even before the war in Germany, and passenger and mail services were experimented with during the war. After the armistice, surfeit of military planes and airplane plants, availability of experienced pilots, greater range and dependability of engines, larger weight capacity of the aircraft, and the destruction of the land transportation network encouraged air transport companies to operate regular routes. In February 1919 Deutsche Luft-Reederei opened the first civil air service from Johannesthal to Weimer, and this route was soon followed with service from Berlin to Hamburg, Munich and Warnemünde. The first international air route was operated by Air Transport and Travel Ltd. from Hounslow (outside London) to Le Bourget, Paris, on August 25, 1919.[303]

The early commercial airplanes were converted bombers produced by Junkers, Rumpler and AEG in Germany, Farman in France, and Airco/De Havilland and Handley Page in England. Windows were cut into the fuselages and interiors outfitted as small cabins seating only a few passengers. The first purely commercial metal aircraft, the Junkers F-13, was developed in 1919. Abandoned factory airfields and operational military airfields such as Hounslow and Le Bourget provided the necessary infrastructure for commercial air operators, but flying was hardly comfortable. Passengers had to tolerate loud engines and cold cabins, engine failures and frequent forced landings, airsickness and general discomfort. Nevertheless, flying got passengers to destinations relatively fast and definitely more adventurously and glamorously than any other available form of transportation.[304]

In his book *International Airports* (1929) Stedman S. Hanks compared air travel with railway travel, drawing an analogy between the air terminal and the railway station, and noticed several similarities in timetables, waiting rooms, concessions and luggage

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[301] Lewis-Dale 1932, 1; Voigt 1996, 27-28.

[302] Ludwig Mies van der Rohe, Walter Gropius and Le Corbusier all worked in the studio of Behrens, who was an influential figure in the Deutche Werkbund.

[303] Some of the pioneering airlines are still operational today, for instance Lufthansa was formed from Deutsche Luft-Reederei and several other companies as early as 1926. Wohl 1994, 285; Voigt 1996, 30-32.

[304] Gordon 2004, 14; Voigt 1996, 32, 39.

handling. This was hardly surprising as both building types were designed to facilitate the movement of passengers, luggage and goods. Hanks described flying for the unfamiliar traveler. According to the Imperial Airways' passenger instructions, which he cited, special clothing was not required, but cotton wool should be placed in the ears to deaden the engine noise. Passengers were informed that light deafness was sometimes caused by atmospheric pressure but it was relieved, when one blew one's nose. Slow taxiing before takeoff was normal, and a diagonal position of the aircraft when turning totally safe. The slowing down of engines indicated reduction of speed in preparation for landing, or the lowering of altitude. Actually, Imperial Airways claimed that airsickness was more rare than seasickness, and dizziness during flight was unlikely. Furthermore, windows could be opened during the flight but nothing thrown out of them. Passengers were always able to communicate with the pilot through the aperture in the front of the passenger cabin, and they had toilets at their disposal in the rear of the aircraft. Additionally, water was served onboard.[305] In the light of this description, it is unsurprising that despite the blooming air transportation industry, most still preferred the safety, comfort, regularity and creditable rapidity of trains and steamships. In fact, traveling longer distances by airplane entailed a series of short flights with landings for refueling at every airfield en route. Hence, to become more competitive not only the airline operators, but also the airfield and aircraft designers gradually had to pay more attention to reliability and passenger comfort.

The architecture of the "first-generation" airfields evolved alongside the growing aviation industry, but there was no consensus on the aesthetics or the layout of the emerging building type. The airport's functional typology took decades to develop and resulted in airfields being completely rebuilt when the old arrangements became obsolete. When aviation first matured from a daredevil sport into a respectable form of transportation, rudimentary buildings were built to serve passengers and accommodate basic functions such as ticketing, luggage weighting and baggage handling. Increasingly room was also provided for the viewers, who accompanied passengers or came to the airfield to catch a glimpse of the aircraft and the glamorous travelers. These early passenger facilities were placed between the hangars on the side of the airfield. When boarding the planes, passengers simply walked the short distance from the terminal building to the airplane parked on the airfield. Airports of this type were built in several European and American locations in the twenties.

By the early twenties the airport terminal was emerging as a new building type. It was a service center, transferring passengers between surface vehicles and aircraft, providing passenger facilities and concessions, and serving as an operating base for air carriers.[306] Early terminal buildings were called air stations, airway stations, *aérogares, Flugbahnhöfe* or *Luftbahnhöfe*. Railway terminology loaned itself naturally to the new building type, because its functions were reminiscent of those of the reception halls of railway stations. Hence, as the function of the airfield evolved from a racetrack to a passenger handling

[305] *Hanks 1929, 68-69.*

[306] Airport Terminal Buildings *1953, 11.*

facility, racing sports terminology was abandoned and new terminology adopted from other forms of transportation.[307]

In his book of how to construct aerodromes (including site selection, layout, construction, drainage, hangar design, construction cost, and maintenance), H. Angley Lewis-Dale differentiated between the various terms referring to the airport in 1932. He claimed that “aerodrome” referred to the airfield and its facilities while “air station” was an alternative term that also referred to service aerodromes equipped with buildings. “Air Ports” were aerodromes having customs and immigration facilities. This term, like “pilot,” was derived from sailing terminology. A “seaplane station” was an aerodrome suitable for seaplanes and “airship station” an aerodrome suitable for airships. He further defined the “landing ground,” which referred to the airfield where landing, taxiing, and takeoff occurred, and the “hangar,” which was a shed for the aircraft. The word “terminal,” which was customarily used for the terminal railway station, first appeared in aviation terminology in the mid-thirties and gradually replaced all other terms after 1945.[308]

Not only the name but also the architectural vocabulary associated air stations with the classical, often monumental architecture of the central railway station. The air station sought to be a similar ceremonial entrance point to the city. This is hardly surprising since the railway station was factually the only existing model for mass transportation and passenger handling at the time. Airport terminals were comparable to railway stations not only because they served as gateways to cities and could be seen as cathedrals of transportation, but also because they were a part of the infrastructure of modern technologies. Considering the lack of suitable ground for airports serving cities and the heavy capital layout involved, airports should have been relatively permanent structures, but instead they evolved through frequent redevelopment and without a comprehensive plan. In fact, early airfields met the technical demands of the new machines, but as aviation developed so airports transformed into infrastructure serving modernized aircraft in the most efficient turnaround time possible. This led to the construction of several generations of airports serving the same city, sometimes on the same site, but most often on different locations due to poor master planning and unrestricted urban growth around the airports.[309]

The air stations of the twenties are “second-generation airports,” which followed immediately after the “first generation,” but were distinguishable by their aesthetic qualities and planning. Le Bourget was such a “second-generation” building. It was not only one of the first commercial airports, but also the site of the first terminal building planned by the Sous-Secretariat de l’Aéronautique in 1922 (fig. 4.3). This airport had an ensemble of neoclassical buildings connected by a neo-Baroque *jardin*. Although purpose-built buildings replaced the motley barracks of the first airfields, the design impractically separated the functions in individual buildings for administration and airline offices, passport and customs control, and weather and telegraph services. The architectural style for Le Bourget denoted it as a ceremonial entry point to the city.

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[307] *Voigt 1996, 27-28.*

[308] *Lewis-Dale 1932, 1-2; Voigt 1996, 33.*

[309] *Lewis-Dale 1932, 4-5; Pascoe 2001, 114, 125-126.*

The same year Le Bourget was completed Hanns Hopp designed an air station in Königsberg, East Prussia (now Kaliningrad, Russia). This air station was placed at an angle between two hangars and united the scattered program of Le Bourget in one symmetrical building with terraces on the flat roofs of each section. The architectural type for the terminal was now apparent, and its buildings were organized according to a recognizable plan. In the layout of "second-generation airports," the air station was placed on the side of an omnidirectional grass field with a paved apron[310] only in front of the hangars and the terminal. The airfields measured 2400 to 3000 feet in diameter and required expensive draining and maintenance. The name of the airfield was usually marked on the apron with giant letters, and other, essential visual navigational devices included signs painted on roofs, rotating beacons and floodlights illuminating the airfields. By the end of the twenties the illuminated airfields at London-Croydon, Amsterdam-Schiphol and Berlin-Tempelhof allowed night flying.[311]

Architects of the Air Ministry designed Croydon Airport (1926-28) in London. It was constructed on a former Royal Air Force and National Aircraft Factory airfield located only 12 miles from the center of the metropolis. This airport had a large concrete apron for airplane maintenance and loading, and importantly was the first airport to have a proper control tower. The terminal building itself was a classical two-story steel-concrete building, which stylistically would have been more suitable as a railway station. The circulation of arrivals and departures was functionally separated and the terminal housed a booking and waiting hall, a bookshop and a reading lounge, a restaurant and a buffet counter. The interior had an array series of clocks displaying times in various cities and a giant map of Europe with information updates about weather, departures and arrivals. At the time it was considered to be one of the best-equipped and most efficiently operated air terminals in the world.[312]

Some airport terminals of the twenties could have been included in the histories of modern architecture. Schiphol airport, located nine miles from Amsterdam, had been established in 1920 to accommodate the needs of the national carrier KLM (Koninklijke Luchtvaart Maatschappij), but the notable terminal building by Dirk Roosenburg was only completed in 1929 (fig. 4.4). The one-story L-shaped brick building was regionalist in its architectural vocabulary, yet functionalist in its dynamic massing that grew out of the specific requirements of the new building type. Outgoing passengers passed through the waiting room and restaurant area, while incoming passengers were routed from planes to automobiles through a station wing and the customs examination hall. The terminal housed customs and immigration offices, waiting room, ticket and post offices, and facilities for the airline and airport personnel. The control tower atop the building, with its

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[310] *Apron (ramp, platform) refers to a defined and usually paved area on the airport, immediately adjacent to the hangars and the terminal, and used to accommodate aircraft for activities associated with the handling of flights.* Apron Requirements for Turbine-powered Aircraft *1958, 53.*

[311] *Voigt 1996, 33-34; Wood 1940, 187.*

[312] *Control tower is a structure so situated and equipped that it allows control of air traffic in the immediate vicinity of the airport. Twentieth Century Building Type 1953, 82; Gordon, 2004, 16; Hanks 1929, 15-18; Wood 1940, 159-163.*

semi-circular viewing platform and control room, followed the forms of railroad signal towers. Schiphol also had a concrete apron, hangars, a restaurant and a hotel. The open restaurant terrace atop the station wing served guests and generated important revenue to balance the airport budget.[313] Schiphol was one of the busiest airports in Europe, and in Wood's view mechanically progressive and efficiently operated. But although Schiphol was a beautifully designed modern airport terminal, it was nevertheless left out of the history of modern architecture. Its redbrick façades, designed by an Amsterdam School expressionist, did not meet the most obvious visual requirement of the modern movement. Had a De Stilj abstractionist designed it, historians of the modern movement might have noticed it.

Another modern terminal that could have been noticed by the historians is Luis Gutiérrez Soto's Barajas Airport in Madrid (1929-31, fig. 4.5). Its streamlined appearance, sleek lines, ribbon windows and terraces supported by pillars resemble functionalist buildings, but the historians neglected it for geopolitical reasons as the history of modern architecture was written from a central European viewpoint. The Barajas airport still stands, but in a greatly altered form. In fact, not many European terminals of the twenties survive: Schiphol's terminal building was replaced, Le Bourget completely rebuilt, and Königsberg demolished. Surprisingly Croydon remained in use until 1959 and is now a registered landmark. Arguably other terminals might have survived had they been included in the history of architecture as representatives of an emerging modern building type.

Several, functionally and aesthetically innovative airport terminals were built in Germany. Tempelhof, which opened for operations in 1923, served as a model airport (fig. 4.6). It had a symmetrical hangar-terminal-hangar scheme of buildings placed at the northern end of the airfield. Connection to the city was facilitated by its location only two miles from the city center, along the main artery, tramline and underground. Systems for ground signals and underground fueling made this airport ultramodern and the name "Berlin" was painted on the concrete apron. Its terminal, which contained a post office, a restaurant, offices and passenger facilities, was constructed according to Paul and Klaus Engler's competition winning design between 1926 and 1929. This three-story, slightly curved brick building had a flat roof and continuous horizontal window bands. Interestingly it was the first terminal intended to be extended at both ends. Unfortunately only two sections of planned four were built before it was demolished and a new one, designed by Ernst Sagebiel in 1935-39, constructed to better meet the needs of expanding air traffic and Hitler's plans.[314]

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[313] *KLM was established already in 1919, which makes it the world's oldest still operational airline. Dirk Roosenburg is also known as the architect for Fokker airplane factories and had previously worked in the office of Hendrik Berlage, another modern pioneer. Curiously, Schiphol was constructed on an area thirteen feet below the sea level and the site had been under Harlemmermeer until mid-nineteenth century. Like many other interwar airports, Schiphol underwent a substantial restructuring in 1967 and was redeveloped into a structure (central terminal, four runways) more suitable for jumbo jets. Hanks 1929, 15-18; Voigt 1996, 41; Wood 1940, 226-231.*

[314] *Voigt 1996, 34-35; Wood 1940, 195.*

Another functionally innovative German terminal of this period was the Fuhlsbüttel Airport (1929, fig. 4.7) in Hamburg designed by Friedrich Dyrssen and Peter Averhoff. This airport was connected to the city by electric suburban railway, concrete highway and trolley line. The long, four-story brick terminal building repeated the curved outline of Tempelhof terminal and was also placed between two hangars at the periphery of the airfield. The upper floors were recessed back on the airside to provide observation terraces. For the first time, the interior of the terminal was functionally partitioned. Rooms for luggage and freight were on the lower level while passenger processing happened on the ground level. A restaurant was placed on the second floor, and administration on the third. The complex arrangement of stairways and ramps ensured that travelers were separated from spectators, who gathered on the airside terraces to see the aircraft. This innovative organizational structure was later repeated on other airports. The airport still exists but in an altered form. Fuhlsbüttel portrayed functionalist features, but despite the continuous horizontal window bands, its dark brick façade, typical to the modern brick style of Northern Germany, maintained a heavy appearance. Neither Fuhlsbüttel nor Tempelhof were noticed when the historians wrote the history of early modern architecture in Germany. *Siedlungen*, factory buildings, and obviously the Bauhaus were emphasized instead.[315]

Not many passengers flew during the interwar period and even Tempelhof Berlin, one of the most successful and busiest airports of the time, had 113 passengers per day in 1928, rising to only 678 passengers per day in 1938. Flying was still a luxury enjoyed by a small elite, and business was not yet sufficient to pay for airports or finance national fleets. The capacity of air travel simply did not cover the cost of running the airport. Hence, to create extra revenues frequent air shows were organized at the airports, and spectators were entertained in restaurants built on the airside of the terminal. Hans Wittwer, the office partner of the Bauhaus director Hannes Meyer, built an exceptionally elegant restaurant building at Halle-Leipzig Airport in 1929 (fig. 4.8). This notably modern building was highly influential for the development of the building type. Its curtain-walled second floor featured a cantilevered roof supported by five reinforced concrete columns with extended arms tapered slightly upwards to evoke an image of wings. This was the first airport building that allegorically referred to flight and its details were echoed in several postwar terminal buildings, including Saarinen's terminal building in Athens. Unfortunately the Halle-Leipzig building has later been demolished.[316] Even though not properly a terminal building, this elegantly modern structure could have been included in the histories of modern architecture the way it was included in the histories of aviation architecture.

In the United States Charles Lindbergh's aerial tour of 1926 attracted aeronautical investment and began a competition among municipalities to convert hangars and grassy airfields into European-styled air stations. Albert Kahn's Ford Airport (1927, fig. 4.9) in Dearborn, Michigan was the first air terminal built in the United States. This airport was

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[315] *Hanks 1929, 10-13; Voigt 1996, 37-38; Terminal station of the Hamburg Airport 1930, 43-48; Wood 1940, 206-209.*

[316] *Voigt 1996, 38-39; Wood 1940, 202-205.*

specifically developed for the Ford Tri-motor aircraft, which was expected to revolutionize flight in a similar manner that Model T had altered the automobile industry. Ford Airport featured the world's first concrete runway, had floodlights and used a pioneering radio system. Its terminal was a simple, stuccoed two-story brick building that had symmetrical façades evoking an image of classical architecture. The interior housed a waiting room and a ticketing office. Ford Airport became the American model airport of the twenties and it still stands in a partly demolished and altered form.[317]

Ford Airport was soon followed by the elegant Pan American Airways Terminal in Miami (1928) designed by Delano and Aldrich, who were to become the most prominent architects of the airports in the United States. This concrete building had a vaulted roof, a balcony for spectators and an interior flooded with light from windows at both ends of the building. Delano and Aldrich also designed PAA's International Air Terminal and Dinner Key Seaplane Base in Miami (1934, fig. 4.10). This three-story terraced structure of plastered concrete walls was intended for long-range, water-based planes. Water-level boarding area and telescoping canopies were used for the simultaneous boarding of up to four flying boats. The terminal building housed a post office, radio station, weather bureau, customs inspection room, and facilities for immigration procedures and medical examinations of foreign incoming passengers. An observation terrace encircled the setback second floor. In Wood's opinion the terminal was efficient in layout and outstanding in materials, design and workmanship. Both buildings served the Pan American Airways operations to Cuba, the Caribbean, and other Central and Latin American destinations.[318] In this sense these buildings were predecessors of the TWA Terminal, which similarly functioned as advertisement for the single airline it served.

Most American airports were designed as classical gateways with historicist allusions. This was evident especially in the Lehigh Portland Cement Company's competition (1929), which attracted design for airfields reminiscent of classical 18th century parks with their composition of aligned runways. Terminal buildings were influenced by the architecture of central railway stations. However, Californian air terminals, such as the Austin Company's United Airport/ Boeing Air Transport Company airfield in Burbank, California (1930) and Henry L. Gogerty's Grand Central Terminal, Glendale (1928) were built in a richly ornamented regional Spanish colonial style. Some American airport architects rejected historical models. Themes borrowed from Art Deco skyscrapers such as setbacks and vertical ribbing, zigzag lines and jazz motifs were also popular and employed in the design of terminals like DeYoung and Roald Architects' Swan Island Airport, Portland, Oregon (1928). Other terminals reflected streamlined machine aesthetics (another kind of Art Deco) inspired by the locomotives, steamships, airplanes, and the work of industrial designers such as Raymond Loewy, who later designed TWA's Boeing

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[317] Building for Air Travel *1996, 102; Gordon 2004, 34-35, 44.*

[318] *The first PAA terminal was demolished and the second one now functions as the Miami City Hall. PAA, under the leadership of Juan Trippe expanded its routes and built a network of airports in many Latin American destinations. Other entrepreneurs such as Robert Lehman and Averell Harriman, who started American Airways (later American Airlines), also made fortunes in the airline industry. In fact, by 1929 sixty passenger airlines operated in the United States. Brodherson 1996, 69-70, 74; Wood 1940, 91-97.*

307 Stratoliner interior, and especially Norman Bel Geddes, who designed the interior of Pan American Airways Martin M-130 –the "China Clipper" (1934-35). However, the modern looks of these terminals hid poorly organized interiors and badly designed circulations routes. A good example of a streamlined airport is the Washington-Hoover Airport (1930, fig. 4.11) designed by Holden, Stott and Hutchinson. This now-demolished terminal was a modest modern building accommodating the then standard aircraft of twelve passengers. Its streamlined appearance evoked the image of steamships, especially with the terraced roofs and a semicircular control room on the second floor.[319]

In comparative analysis, geography and socioeconomic context were decisive factors in the differing development patterns of aviation in Europe and the United States. The major difference between American and European aviation was that American airports were municipal or privately owned, commercially oriented airports whereas their European counterparts were most often built, managed and owned by the national government. This guaranteed the fast, secure and successful development of European airports. Furthermore, geographical conditions made international aviation a necessity in Europe, facilitated agreements about border crossings and contributed to the construction of passenger terminals with a functional layout to handle international travel, customs inspections and immigration procedures. Aviation and airport planning were regulated by governments, which were also heavily involved in creating national airlines.

But there were also differences in development and government subsidies among the European countries. Politics, geography, the relative distance between major cities, and the existing alternative traffic networks influenced national developments. Aviation advanced especially fast in Germany, where the Treaty of Versailles allowed commercial aviation but forbid the maintenance of a military air fleet. The Germans were also particularly enthusiastic about the new technology. Furthermore, German airports were owned by cities that competed in building them, whereas elsewhere in Europe airports were operated by the national government.

However, the United States did take the lead in nighttime flying and airmail service, which developed faster where distances between major cities were substantial. Aviation was a private business until the Air Commerce Act (1926) was passed to promote and regulate the development of air transport and its infrastructure. It divided the responsibilities for airport design and navigational aid development between federal government and local authorities, making maintenance of airways and navigational aids a federal responsibility, while the construction, operation and financing of airports was a local, municipal task. Hence, the majority of American airports were built by municipalities, often in collaboration with airlines or manufacturers such as PAA or Ford. Yet, during the Great Depression airport construction benefited from the Work Projects Administration (WPA) and Civil Works Administration (CWA), federal relief programs

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[319] The terminals at United Airport and Glendale still stand in altered form, but San Francisco's terminal has been demolished. Interestingly Air Mail Act required aircraft factories to separate from commercial airlines. Thus the Boeing Air Transport Company, for which the United Airport was built, was divided into Boeing Aircraft Company and United Airlines. Brodherson 1996, 68-74; Gordon 2004, 47-52; Wood 1940, 141-144.

that specially allocated funds to the improvement of runways and aprons. For the first time the federal government financed the construction and improvement of municipal airports. But it was only in 1938 that the Civil Aeronautics Act finally allowed airports to be funded as part of a national defense strategy and established the Civil Aviation Authority (CAA) to regulate civil aviation.[320]

Some of the "second-generation" air stations of the twenties and early thirties discussed here, both in Europe and the United States, were modernist in their functional layout and stylistic features such as horizontal bands of windows, flat roofs, semicircular details, and terraced structures. In the United States certain air stations had a distinctly streamlined appearance. Nevertheless, most of them lacked the lightweight appearance of modern architecture and were left unnoticed by historians of the nascent modern movement. Despite serving the most modern transportation technology imaginable, they did not express the space-time, interpenetration of interior and exterior space, or the "first machine age" in the sense defined by the historians Sigfried Giedion and Reyner Banham. Even the Art Deco airports reflected the inner spirit of the machine in a different architectural vocabulary than expected by the historians. Instead, these airport terminals were utilitarian structures aiming to clarify and spatially organize the program of the airport. Aesthetic considerations focused on creating a representative entrance point on the landside or served the corporate image of the airline as in the case of Pan American Airways terminals. Because they were so closely associated with modern technology, these buildings did not aim to express the machine. This sort of symbolism was sought after only in the following "generation" of airports.

4.2. Terminals of the Thirties

Architects, who approached the design problem ambitiously, both from the functional and aesthetic viewpoint, designed airport terminals of the thirties. Some of these terminals provided important models for the technical development of airport typology. But while there was an increasing consensus about the plan and functional layout of the terminal building, a variety of styles were employed to express its function as an entrance point to the city. Some architects chose monumental neoclassicism while others utilized streamlined machine-inspired aesthetics, or functionalist vocabulary to portray progressive modernity.

As Reyner Banham observed in his insightful 1962 article "The Obsolescent Airport," airports were dragged along by the development of aircraft, but were never quite up-to-date, always inadequate, and never complete. Banham claimed that poor financing and incompetent planning were the causes for airports' aesthetic and functional inadequacies. Airport development had started in what he called the pastoral phase: the era of slow and light aircraft landing on grass field. What constituted an airport were a hangar and a petrol-pump somewhere at the edge of the grass airfield. As the travel volumes increased,

[320] *WPA had a special Division of Airways and Airports that renewed aerial network and built new airports. Brodherson 1996, 67-68; Hanks 1929, 6-7; Szurvoy 2003, 40-47, 70-82; Voigt 1996, 39.*

separate buildings were provided for passengers and the consequent rush hour of the skies made control towers necessary to supervise airspace.[321] Nevertheless, as Le Corbusier had already noted during his first flight in 1928, airport planning lacked sensitivity to spatial identity and geographical location.[322] In other words, there was no architectural master planning. Airports were built to correspond to immediate needs without a vision of the future of the airport or the aviation industry.

At the beginning of the 1930s, it was already time to evaluate the problems of existing airports and the future perspectives of the building type. Lewis-Dale argued in 1932 that within a generation, the airplane had not only developed into an efficient form of passenger, freight and mail transportation, but had also revolutionized warfare. Other uses of aviation included aerial photography for mapping and the topographical survey of land, rescue and medical aid, customs patrolling, and crop spraying. Therefore, it was very surprising that airports lacked efficiency and artistic imagination. In Lewis-Dale's view the ill-designed landing grounds and temporary, inadequate buildings were the lingering result of fast wartime construction. He stressed the importance of foreseeing future requirements in the very first planning stage so that even temporary structures could be placed within an overall site plan. In his opinion, airport should allow a clear run of at least 300 feet in all directions without any high structures on approach routes, and irregular confusing aerodrome shapes should be avoided. Wind and weather conditions naturally decided the site selection, but connections to the city by rail and road were equally important. Buildings were to be placed in the direction of the least frequent winds, and grouped according to their function. Furthermore, the rapidly increasing size, weight and landing speed of aircraft damaged the turf of landing grounds and suggested that more attention should be given to airfield planning.[323]

At the turn of the decade architects were then becoming increasingly aware of the new building type. They sought to redefine the program of the airports, which so far had most often been formulated by government offices such as the British Air Ministry and le Ministère de l'Air. In 1928 the Royal Institute of British Architects (R.I.B.A.) organized a competition for young architects to design an airport for the year 1943. This and other competitions generated new ideas for the airport, which was now approached as a complex planning problem. Furthermore, it was evident that the airport required a master plan. Frequent flights and the growing weight and dimensions of the aircraft created new requirements for the terminal building, the airfield and site selection. For instance, Tempelhof and Croydon had as many as ten takeoffs and landings during peak hours in 1936. Up till now aircraft had been boarded on the airfield, but in the thirties multiple takeoffs and landings made this practice hazardous and the airfield prone for accidents. Therefore the Lehigh and R.I.B.A. competitions included proposals for innovative tunnels or bridges leading from the terminal to the airplanes that would wait in parallel rows on the apron. These solutions provided a protective roof and foreshadowed the designs of the late 1930s. The Lehigh competition also had a far-reaching formal legacy that may still be

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[321] Banham 1962b, 252-253.

[322] Le Corbusier 1988 (1935), 7.

[323] Lewis-Dale 1932, 6, 14-18, 24-30.

traced in the geometrical runway layout at Idlewild (JFK), O'Hare and Heathrow airports. At this time, however, it was uncertain whether the land-based airplane, the seaplane or the airship would become the dominant type of international travel. Therefore seadromes were built as frequently as airports, and many important airports, for instance LaGuardia Airport in New York City (1937-39), operated as airplane terminals as well as marine air terminals.[324]

Special attention was increasingly given to the analysis and improvement of the form and surface of the airfield's runways. In the thirties expensive landing strips with paved surfaces, of the kind that had been standard in the United States since 1928, were also introduced to European airports. In Europe, design had previously focused on terminal buildings and hangars, whereas in the United States airports were also approached as a civil engineering problem and improvement concentrated on the design and functionality of landing fields. The Army Air Service had already developed specifications for municipal airports, including a recommendation for a cross-shaped layout of concrete runways. Gravel, crushed rock and coal cinders treated with oil dressing had also been experimented with as surface materials. The first paved runway in the world was built at the Boston Municipal Airport in 1923, followed by the first macadam runway at Newark in 1928, and the first concrete runway at Ford Airport in 1929. Runway arrangement plans entered airport design slowly, but eventually were to determine the location of the terminal and the taxiways (the connecting paved link between the apron and the runways), hence changing the layout of the airport.[325]

Advances in aircraft design further focused attention on the airfield as the Boeing 247 and Douglas DC-1 entered service in 1933, followed by the DC-3 in 1936. These planes were heavier and could carry more passengers. The DC-3 was the first airliner capable of making a profit. Aided by its two engines and aerodynamic aluminum airframe it could carry a substantially higher load relative to its weight and fly its 21 passengers faster and further than its predecessors. At the same time it set new requirements for runways and passenger handling facilities. As the airport consequently became a more complex system, airport design encouraged the development of specialized architectural firms, such as Norman and Dawbarn in Britain, Ernst Sagebiel in Germany, and Delano and Aldrich in the United States. Other specialists in airport architecture including Eero Saarinen and Helmut Jahn in the United States, Paul Andreau in France, and Norman Foster in the United Kingdom have followed these firms.[326]

In the thirties, the "third-generation" European airports had four or more paved landing strips, allowing airplanes to takeoff in various wind directions, and a scheme for expansion that restricted non-airport development in the surrounding area. The first airport equipped with a complete system of paved runways was Stockholm-Bromma Airport,

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[324] American Airport Design *1990 (1930); Voigt 1996, 43-45.*

[325] *At the time when most European airports still sported grass airfields, Lewis-Dale recommended cement concrete with a granolithic surface of tarmac, or asphalt concrete (crushed rock, gravel and sand bound with asphalt bitumen) for the areas used heavily by the machines. However, landing grounds needed a softer surface of oil or bitumen emulsion mixed with a suitable grade. Lewis-Dale 1932, 35-40, 56.*

[326] *Lockhart 1996, 215-216; Voigt 2005, 17.*

completed in 1936. Before the Second World War paved landing strips were also constructed in Amsterdam, Moscow, Bremen, and Helsinki. Another novelty was a wedge-shaped building zone projecting from the edge to the center of the airfield and leaving 80 percent of land undeveloped. This scheme, developed by the French engineer A. B. Duval in 1929, allowed flexibility in operations and was first realized in Lyon (1931) and then in Birmingham (1937) and Helsinki (1937-38).[327]

Airport designers also approached the airport in a functionalist manner that resembled the German architect Alexander Klein's functional studies to kitchen and room arrangements in the 1920s. Scientific research along Taylorist lines produced diagrams of aircraft movement on the ground, and time and motion studies aimed to increase rationalization and efficiency. The Berlin Airport Company commissioned time and motion studies already in 1930.[328] Such studies became standard later and were utilized by architects like Saarinen, whose office did extensive research for its airport commissions in the 1950s.

The new terminals of the thirties, which often replaced old ones, were not only impressive in their monumentality but also technically innovative. For instance, Georges Labro redesigned Le Bourget according to his competition-winning proposal of 1935 (fig. 4.12). Its slightly streamlined, classicized modernism was exemplary of the stylistic features employed in many public buildings of the period. This long, three-story modern building was clad in natural stone and designed to be extendable at both ends. Its reception hall ran the length of the entire building and received natural light through glass bricks in the concrete-shell roof. The flight control balcony was the only element interrupting the otherwise horizontal, elegant airside appearance. This building still stands, albeit in a slightly altered form, and houses the Musée de l'Air et de l'Espace.[329]

Ernst Sagebiel redesigned Tempelhof airport in 1936-39 (fig. 4.13). Commissioned by the Nazi regime, this massive building was the largest terminal in the world and intended as an international gateway to Germany. Its neoclassical façade, which was clad in limestone and stripped of ornamentation, was located immediately off Albert Speer's proposed north-south avenue across Berlin. Passengers arrived on a courtyard surrounded by four-story administration wings, entered the reception hall, and then progressed to the departure hall on the airfield side. On the airfield side a 40-foot-high canopy was cantilevered out 170 feet along the entire length of the building. Passengers were expected to "dry board" under the protective roof that did not only shelter the passengers but even the largest aircraft. The roof was intended to serve as a viewing platform and was therefore accessible by staircases. Curiously only the public façade of the building was constructed in the politically preferred National Socialist style, while the airfield side and interior revealed the actual reinforced concrete skeleton and innovative design features influenced by *Neue Sachlichkeit* or New Objectivity, the style guiding construction of

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[327] *Voigt 1996, 44.*

[328] *Voigt 2005, 18-19.*

[329] *Rignault 2005, 73-82; Morisseau 2005, 145-157; for discussion on Le Bourget see* L'Architecture d'Aujourd'hui *1936, 2-57; Wood 1940, 187-193.*

transportation infrastructure of the time. Closed down in 2009, Tempelhof is an impressive monument of its era.[330]

Gatwick Airport, designed by Hoar, Marlow and Lovett in 1936, had an innovative circular terminal building with a tunnel connection to the railway station that served the airport (fig. 4.14). The terminal processed as many as six planes simultaneously as they were parked in a circle around the building. Passengers boarded the airplanes through gates and telescoping passageways that moved on electrically motored rails. Similar passageways had already been used at Oakland Airport in Berkeley, California in the twenties but this was the first time they were working as a system. Thus, Gatwick was a predecessor of the sixties' terminals in Los Angeles (1961), Toronto (1964), Geneva (1968) and Paris (1974) that had insular (or satellite) systems of arrival/departure gates connected to the main terminal. Gatwick was criticized because its circular form made extension impossible, although its "beehive" structure could have actually been repeated to create a larger airport ensemble. The terminal still stands accompanied by two later terminals of a different type.[331] Inspired by Gatwick, circular terminals were also built at the Budaörs Airport, Budapest (1937, now slightly altered, Virgil Borbiró and Lásaló Klárik) and Helsinki-Malmi Airport (1937-38).

Other noteworthy terminals of this period were the Elmdon Airport (1938-39) by Norman and Dawbarn near Birmingham, and the Municipal Airport of Ramsgate designed by D. Pleydell-Bouverie, completed in 1937 and demolished in the 1980s (fig. 4.15). These buildings and the imagery of flight they portrayed could be viewed as predecessors of Saarinen's TWA Terminal. Elmdon's terminal evoked the image of the aircraft with two, fifty-foot long, protective canopies on each side of the four-story round terminal. Ramsgate's streamlined pavilion was fully glazed on the airside and tapered at the ends. The control room, set atop the concrete platform, resembled the nose and cockpit of a plane. Its form was similar to the streamlined fantasy high-wing airliner, with its passenger cabin suspended under the wing, that Norman Bel Geddes and Otto Koller published as Airliner Number 4 (1929-32).[332]

Some of the finest examples in functionalist airport architecture were built in Scandinavia. Copenhagen-Kastrup Airport was built in 1936-39 to the competition-winning design by Vilhelm Lauritzen and later extended by the same architect. This four-story ferroconcrete terminal had long glass façades and a protective cantilevered canopy along the airfield side. Interior walls were covered in birch parquet, and acoustic tiles were

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[330] *Nazis were well aware of the potential of the aircraft and used it in ceremonial parades. For instance, Leni Riefenthal documented the Nürnberg meet from an airplane. Tempelhof was to symbolize the regime and its innovations in aviation. Specialists and statesmen from various nations traveled to see the magnificent air station, unforeseen in its size and technical progressiveness. Essentially then Tempelhof was utilized as a propaganda tool. Tempelhof's significance for Berlin was demonstrated during the Airlift 1948-1949, when flights carrying food, fuel and other goods landed or took off from the airport every five minutes. Drieschner 2005, 100-111; Hecker 2005, 92-99; Pascoe 2001, 157-163; Voigt 1996, 48-49; Wood 195-201.*

[331] *Voigt 1996, 36; Voigt 2005, 19; Wood 1940, 165.*

[332] *Wilson, Pilgrim & Tashjian 1986, 127; Voigt 1996, 47. Ramsgate Municipal Airport 1937, 3-6.*

utilized on the undulating ceiling to dampen noise.[333] The terminal building at Stockholm-Bromma Airport (1935-36, fig. 4.16) was constructed according to Paul Hedquist's competition-winning proposal. This relatively long, low and narrow, functionalist building had a steel skeleton, concrete floors, aerocrete walls finished with cement plaster, and large areas of glass. A glass-enclosed control room was placed at the southwest corner of the building. Incoming and outgoing passengers used separate entrances at the opposite ends of the concourse while a central opening served luggage handling. Unfortunately this airy, simple and functional terminal was rebuilt in 1948-49.[334] One of the best-preserved air terminals of the thirties is the Helsinki-Malmi airport, designed by Dag Englund and Vera Rosendahl in 1937-38. This aerodrome was the second in Europe to have a paved runway. Its circular terminal, which has an impressive three-story high central hall, ribbon windows, two wing buildings, a canopy sheltering passengers and a control tower atop, remains in virtually unaltered form. The terminal is still used for general aviation, but its future is debated, as the City of Helsinki plans to redevelop the airfield into a residential area.[335]

Other functionalist airport terminals in Europe include Milan-Linate Airport (1937, fig. 4.17), designed by Gianluigi Giordani in the Italian rationalist style of the 1930s. This elegant, plastered, reinforced concrete terminal with large windows was placed on stilts so that cars could park underneath. An automobile ramp led to the main entrance on second floor and facilitated passenger drop-off. On the airside a long, glass-enclosed passenger ramp led down to the apron and nearby an artificial lake served seaplanes.[336] In Czechoslovakia, Prague-Ruzyne Airport (1933-37, now slightly altered) was designed by Adolf Benš and built according to a comprehensive plan unlike most other airports in Central Europe. The simple, angular, two-story terminal consisted of a main block, narrow wings and a three-story control tower.[337] This airport formed a comprehensive whole and not a heterogeneous collection of buildings added to the airfield along its operational lifespan. However, despite their modernity and known architects, even these airports were overlooked when the narrative of modern architecture was constructed.

In the United States, two airports of the late thirties with comprehensive plans for terminal architecture and runway layout are of interest. This is especially so because they form the context for the planning of Saarinen's Dulles International Airport and TWA Terminal. Washington National Airport (1941, fig. 4.18), serving Washington D.C., was built as a gateway to the nation and cathedral for modern transportation. National Airport was exceptional in that it was operated by the Civil Aeronautics Administration and intended as a national model for airport planning. The geometrical layout pattern of four runways served modern aircraft such as the Boeing 247 and Douglas DC-3. The monumental terminal's landside façade reflected the neoclassicism of the Capitol across the river, while the airside featured a long curtain wall and streamlined spectator terraces.

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[333] *Gordon 2004, 87; Hanks 1929, 30-32; Wood 1940, 155-156.*

[334] *Wood 1940, 257.*

[335] *Gunningham 2012.*

[336] *Wood 1940, 233-235.*

[337] *Wood 1940, 151-153.*

The reinforced concrete and steel structure, designed by Howard Lovewell Cheney and Charles M. Goodman with the aid of a large design review committee,[338] merged streamlined Art Deco with a classicist architectural vocabulary to meet the challenge of contemporary design ideals and its site by the Potomac River.

The design of National embodied many of the "Nine Points of Monumentality" that Sigfried Giedion, Josep Lluís Sert and Fernand Léger had suggested in 1943 were required to meet the needs of postwar civic centers and landmarks. "Nine Points of Monumentality" called for vast urban schemes, where modern buildings would represent social and communal life. They promoted a synthesis of the arts so that architects and artists would collaborate with planners to invent new techniques and forms of expression. Furthermore, nature and man-made elements were to be integrated into total landscapes visible from the air so that the lyrical value of cities could be revealed.[339] National Airport was approached as a total planning problem and part of the urban scheme. A large number of design professionals were engaged in the planning of the airport, which at the time of its opening was represented as a symbol of unified wartime culture. Intended as a site of weekend outings and airplane viewing, National was designed to be experienced as a spectacle of air views, and aircraft taking off and landing on the runways.

National's long, flat-roofed and terraced terminal had five stories on the airside and four on the landside. Services such as mail and baggage handling were placed on the lowest floor. The two-story passenger waiting room above it had a ticket counter at the rear and a slightly lower level observation promenade, which extended the length of the building and led to narrow passenger concourses at each end. Passengers would proceed from the landside entrance to the ticketing and the promenade, and continue to the concourses and the four staircases leading to the airplanes parked on the apron. Staircase from the waiting room provided access to a third-floor dining room with an outdoor terrace. The setback fourth floor housed a pilot's room, control and communication offices, and weather bureau. The encircling, exterior observation terrace on the airside second floor accommodated viewers. In addition, it was intended to serve as a loading platform for the newest passenger planes with tricycle landing gear that would place plane doors at approximately this level. While the building's architecture was widely praised, it was also criticized for neither separating incoming and outgoing passengers properly, nor providing for possible expansion. This building survives as part of an enlarged terminal complex and provides a genuine sense of period aviation and its architecture.[340]

Delano and Aldrich designed the New York Municipal Airport in 1937-39, which was renamed LaGuardia in 1947. It was funded to a large extent by WPA, and opened for the

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[338] *Committees involved included Interdepartmental Engineering Commission, three design review committees, several architecture and engineering firms, Commission of Fine Arts, National Capital Park and Planning Commission, and President Roosevelt, who was unusually interested in the architecture of the city. Ethel Pilson Warren designed the interiors. Brodherson 1996, 79-81.*

[339] *Giedion, Sert & Léger, 1993 (1943), 29-30.*

[340] *Brodherson 1996, 79-81; Gordon 2004, 117-121; Ward 2009;* Design and Historic Preservation: The Challenge of Compatibility *2002, 177-195; Wood 1940, 136-140;* Washington National Airport *1941; New Buildings: Washington National Airport 1941, 48-57; Hudnut 1941, 169-176.*

New York World's fair. Before the opening of the airport New York was only served by the inadequate Floyd Bennett Field in Brooklyn and the Newark Airport, which to the embarrassment of New York was made the regional airmail terminus in 1935 due to its convenient location on railroad and express highway networks. Newark Airport was the world's busiest airport at the time and embodied a new operations-oriented approach to airport design. It featured four cinder-surfaced runways, four airway stations serving individual airlines, and a municipal terminal. Criticized for the inefficient and costly splitting of services, it was nevertheless a successful airport model, defined by Wood as a "smoothly functioning organism, providing a steady and fluent movement of aircraft, passengers, merchandise, mail, and surface vehicles." In contrast, Wood felt that Floyd Bennet resembled a railway station rather than a modern air terminal.[341]

The initiative for the New York Municipal Airport came from Mayor Fiorello LaGuardia, who foresaw the importance of aviation and decided to develop a former Curtiss-Wright Corporation Airfield at North Beach in Queens as a modern, international airport. He incorporated the new municipal airport in a citywide Depression-era transportation improvement program that also included tunnels, bridges and parkways, and he lobbied for federal funding. The new airport, nine miles from Grand Central Station, was reached from Midtown Manhattan in only twenty minutes on Grand Central Parkway and the Triboro Bridge. The New York Municipal Airport had a terminal for the domestic routes served by land planes, another for transatlantic flights operated by flying boats, and several hangars serving both. At this stage of air transportation, the planes with the largest capacity and the greatest range operated on water, eliminating the costly construction of the long concrete runways they would have otherwise required for takeoff. The Marine Air Terminal (fig. 4.19) was influenced by William A. Delano and Chester H. Aldrich's training in the Beaux-Arts tradition, although they chose a distinctly Art Deco vocabulary for the whole airport scheme. The Marine Air Terminal was a three-story, flat-roofed, circular, and setback structure in which the upper drum was of stainless steel and glass. Three one-story wings that extended from the building housed customs and captain's offices, the weather bureau, radio room, and airline offices. Ornamentation throughout the building was inspired by aviation.

The Administration Building and Terminal was an ornamented rectangular building with a four-story semicircular central portion and a control tower. The innovative passenger circulation pattern separated enplaning and deplaning passengers on different levels. Enplaning passengers entered the second floor from an upper-level roadway and proceeded into the ground-level curved loading platforms, which extended 750 feet from the center of the terminal and enabled simultaneous loading of twenty-one planes. Deplaning passengers walked into the terminal and ground transportation arranged at the same level. The upper level was preserved for luxurious dining room and bar, dining

[341] The New York World's Fair had a particular emphasis on aviation under the theme World of Tomorrow and had an aviation pavilion designed by William Lescaze. General Motors Futurama, designed by Norman Bel Geddes (1893-1958) with the help of Eero Saarinen, portrayed an air view of the United States in the 1960s with regional airports, highways and a circular airport. Gordon 2004, 115-116; Wood 1940, 99, 119, 326.

terrace, observation and service facilities for visitors. The building also housed services such as post office, baggage and express rooms, first-aid, conveniences, ticketing, and executive offices. The New York Municipal Airport had the world's longest runway (6000 feet) and a revolutionary pattern of the macadam-surfaced runways and apron. In his evaluation of the airport Wood praised the runways and the innovative design of the loading deck, hangars and lighting equipment, but he criticized the site selection that had poor air approaches from several directions, made some landing areas too narrow, and had only limited possibilities for expansion. This eventually led to the construction of a new international airport.[342]

Even when architects in the thirties approached airport design problems systematically, the results were still criticized for not being rational enough. Banham in 1962 gave a devastating evaluation of the monumentalized airway stations: "like all monuments of technological culture, they were by definition dead, superseded before they were designed." He was right in a sense that these airports were accommodating aircraft types that soon became obsolete. New aircraft and growing passenger volume demanded more functional buildings. The new generation of speedy, comfortable, and reliable postwar aircraft, the direct descendants of World War II bombers, culminated in the Lockheed Constellation, which was designed as a military plane in 1939, then transformed into civilian use in 1943, and produced until 1958. In Banham's opinion Constellation was the absolute Platonic ideal of an airliner. The standards developed for it were imposed on every airline in the world for the following two decades, and increased traffic resulted in heavier, bigger and faster versions of the ideal aircraft. Furthermore, in Banham's view airport plans disintegrated when the operations were concentrated on narrow runways at the center and terminal and hangar buildings placed freely anywhere on the airfield.[343]

Writing in 1940, Wood blamed inadequate initial planning for the constant remodeling and modernizing of airports. In his view, periods of incapacity and the waste of economical resources could have been prevented if future needs for expansion had been calculated at the initial planning stage and if airports were built as permanent structures. He suggested that site selection should in the future ensure clear air approaches and safe climbing ratio, consider local atmospheric conditions, topography, connections to the city and other transportation systems, allow for expansion, and insure unlimited supplies of water and electricity. Furthermore the airfield should have a geometric, rationally planned layout and an orientation in the direction of the prevailing wind. Runway layout should

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[342] *Wallace Harrison of Harrison and Abramovitz designed a new terminal building for LaGuardia in 1964. The impressive, 1,250ft long, partly two and partly four-story, curved glass-and-steel building was designed along the tropes of International Style modernism. Two-level roadway led to the terminal and a twelve-story control tower finished the overall scheme. This building replaced the Delano and Aldrich landplane terminal and has since already been altered when the adjacent roadways were widened and a large parking garage added to the scheme. However, the flying boat hanger still survives. The Marine Terminal was designated a historic structure in 1980 by the Landmarks Preservation Commission of the City of New York and as a result of careful adaptive use it still serves flyers. Gordon 2004, 107-114; Brodherson 1996, 76-78; Mellins 2005; Wood 1940, 111-118.*

[343] *Banham 1962b.*

allow safe simultaneous landings and takeoffs and reduce plane taxiing. Plane-loading platforms should be centrally situated, and they should protect passengers from blast and roar of airplanes, reduce plane maneuvering to the minimum, allow for simultaneous loading and unloading of several planes, and facilitate plane transfers. Incoming and outgoing passenger flow as well as freight traffic should be separated on the loading platform and in the air station building. Airport buildings should be centrally located in a relatively narrow airport frontage, and allow smooth circulation and efficient airport control.[344]

Wood's well-formulated articulation of these principles of airport planning formed the basis of postwar airport planning. Some airports of the thirties also provided models for the future development of airport terminal typology. For instance, Tempelhof pioneered the canopy structure and the parallel loading position for airplanes, Gatwick the circular satellite terminal with telescoping passageways and train connection, and Le Bourget exemplified the efficient long rectangular facility with minimum distance between the entrance and the aircraft on the apron. However, while there was evolving consensus about these planning principles, there was a striking confusion about aesthetics. Some airport terminals of the twenties and thirties like Englers' Tempelhof and Labro's Le Bourget were modern, Sagebiels' Tempelhof monumentally neoclassical, Roosenburg's Schiphol represented regional brick aesthetics, Kastrup portrayed Scandinavian modernism and the American airports oscillated between historicism and streamlining. Some airport terminals, like Ramsgate, imitated the image of an airplane, but most functionalist airport terminals were merely inspired by machine aesthetics. Nevertheless, by the end of the thirties airport terminal had developed into a recognizable building type defined by its plan, not style.

The operational airports of the twenties and thirties differed strikingly from the avant-garde visions discussed in chapter 3. These airports are absent in the histories of modern architecture, which seem to recognize only Nervi's hangars (for instance at Orbetello 1939-40), and Saarinen's TWA Terminal, and instead concentrate on Le Corbusier's and Sant'Elia's unrealized plans and visionary drawings. Nervi's and Saarinen's later buildings are celebrated as ingenious designs of well-recognized planners and, admittedly, it is reasonable for historians to concentrate on such masterpieces that display ingenuity by well-known designers. Interwar airport terminals were not included in the canon since first, they were not designed by the modern masters and second, they did not aesthetically meet all the visual requirements of the modern movement. Furthermore, these buildings did not benefit the historians' project to define the vocabulary and genealogy of modern architecture.

It could be claimed that many of the early terminals lacked artistic vision. But when even functionalist terminals of the 1930s are excluded, it suggests that the problem might lie within the building type and the lack of interest in the new design problem. Leading modernists concentrated on villas, apartment building and public projects including hospitals, factories and assembly halls. They were radically redesigning existing building types where the difference between modern architecture and historicist styles was

[344] *Wood 1940, 7-13.*

demonstrable. These were also building types advancing social reform. By contrast, the airport terminal was a genuinely new building type. Rather than providing possibilities for radical redesign, this building type posed questions about the functional and aesthetic requirements of the airport. Therefore its history reveals a plurality of technological possibilities, alternative architectural development patterns and various modernist idioms that were present when modern architecture was institutionalized.

The Second World War was a decisive factor in the development of aviation. Aircraft production increased exponentially, and, especially in the United States new factories were constructed and existing facilities converted into airplane plants. These facilities, along with military innovations, made mass production of aircraft possible.[345] Actual airport construction during the war was limited. Instead most civilian airports were taken over by governments and civilian air operations halted. Military airfields built during the war had only basic facilities for operations and maintenance, and should therefore be viewed as transportation infrastructure rather than architecture. Nevertheless, the number of airfields and air bases increased during the war and in the aftermath of the war over 500 rudimentary surplus military airfields were transferred to municipal authorities in the United States. In addition Airport Development Plan, i.e. the defensive air network plan for Latin America, built twenty-five airports in fourteen countries and thus created the basis for modern aviation and airport facilities in the area.[346] Some of the finest hangars in the history of aviation were not only constructed but also destroyed during the war in Europe. Pier Luigi Nervi's magnificently vaulted concrete shell hangars in Orvieto, Orbetello and Torre de Lago (1935-41, fig. 4.20) were structurally innovative and expressionist precedents for postwar architecture and their fame lived on in widely circulated publications.[347] Other airfields were also bombed and partially destroyed.

In the direct aftermath of the war, civil aviation took full advantage of wartime innovations and new technologies, surplus aircraft production plants and skilled labor to expand the air transit network and modernize its infrastructure. Aircraft manufacturers also tried to convert surplus bomber assembly plants into peacetime use. For instance, Beech Aircraft in Wichita, Kansas manufactured Buckminster Fuller's Dymaxion Wichita House (1927, redesigned 1946). This house, whose name meant "dynamic plus maximum efficiency," was an adaptation of the light-metal methods used in aircraft construction. It integrated mechanical services in the center of the house from which heating and lighting, entertainment and cleaning, nourishment and ventilation were distributed into the surrounding living space. Thus the plan was liberated from conventions. In Fuller's view housing shortage could be relieved if surplus manufacturing plants, materials and expertise were utilized to produce such lightweight and low-cost high-efficiency housing.

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[345] *During the war, Defense Plant Corporation financed industries such as aircraft factories and shipyards. To give an idea of the scale of production, aircraft production grew from 13,000 in 1940 to 125,000 in 1943. Concerns about the concentration of aircraft plants on the coastline and especially California led to the construction of bomber assembly plants in Tulsa in Oklahoma, Omaha in Nebraska, Fort Worth in Texas and Kansas City in Kansas. Davidson 1995, 192-202.*

[346] *Gordon 2004, 132-134.*

[347] *Voigt 1996, 37;* Pier Luigi Nervi: Bauten und Projekte *1957, 28-43.*

A similar project was the Vultee house, designed by Henry Dreyfuss and Edward Larrabee Barnes in 1946 and produced by Consolidated Vultee Aircraft Corporation's Los Angeles aircraft factory. This house was similarly constructed with high-strength, lightweight aircraft panels, manufactured with thin aluminum glued and bonded on a cellular paper core. These houses never went into mass production but these and similar projects demonstrate the impact of aviation related industries and technologies.[348]

4.3. Postwar Airport Terminals

Postwar airports were grand modern structures with spectacular terminals that gave form to the jet age, but they did not emerge from a void. Instead, most terminals found precedents in the typological history of the airport and were erected to update existing airfields. Therefore, in order to fully appreciate aviation architecture, the silenced history in-between the early avant-garde visions and these heralded postwar airports needs to be acknowledged. The greatest postwar airports in the United States were designed by second-generation modernists and included Lambert St. Louis Airport (1951-56) by Hellmuth, Yamasaki and Leinweber, Chicago O'Hare International Airport (1957-63) by C. F. Murphy, Saarinen's Dulles International Airport in Washington D.C., and the terminal complex at New York International Airport (1957-71), designed by Saarinen, SOM, I.M. Pei and others. Some of these airport terminals were the first examples of their building type to find a place in the histories of modern architecture in the sixties and seventies.

In Europe there was a comparable spurt of airport construction: M. Duintjer architects and Netherland Airport Consultancy (NACO) designed the new Schiphol Airport in Amsterdam (1963-67), Aéroports de Paris and Henri Vicariot designed Orly Airport in Paris (1957-61), Frederick Gibberd and Partners Heathrow International Airport Terminal (1955-1970), and Aéroports de Paris and Paul Andreau constructed Charles de Gaulle, Terminal 1 (1967-1974). These European airport terminals were not mentioned in the written histories, but neither were they designed by modernists such as Saarinen or SOM, whose work in its totality was acknowledged in the canon of architectural history.

In the postwar era mass air transit became reality. Especially Americans, who were unburdened by the reconstruction effort, traveled abroad in masses. As passenger volume multiplied, new airlines were started, more warplanes were converted into civil use, and new airports were built to serve the booming business. From 1945 to 1954 the number of passengers flying each year within the United States grew from 6,7 million to 30 million, and in 1956 Americans aboard aircraft crossing the Atlantic outnumbered those aboard transatlantic ships. Pan Am, TWA, American, Braniff and Northwest had regular connections to Europe and hotel chains such as the Intercontinental Hotel Corporations, established by Juan Trippe, who founded Pan Am in 1946, accommodated American tourists oversees. Modern, overseas hotels with their climate-controlled rooms, shops and

[348] *Fuller 1993 (1946), 87-92; Reed 1995, 27-29.*

restaurants became nodes in the air transit network and were often seen as representations of American culture and free-market capitalism abroad.[349]

The emergence of the jet engine resulted in what the historian of technology Edward W. Constant calls “the turbojet revolution.” He argues that problems related to a certain technology (such as functional failure, incapacity to function under more stringent conditions or cost related issues) are usually solved within existing functional systems, but occasionally more radical alternative solutions are required. In the case of the aircraft, aerodynamic theory suggested already in the late twenties “that with sufficient thrust, well-streamlined aircraft should be capable of approaching the speed of sound; that conventional propellers could not operate efficiently at such speed; and that gas turbine compressor and turbine components designed in accordance with aerodynamic theory should be capable of significantly higher efficiencies than previously thought possible.” Together these three insights constituted what is called a presumptive anomaly, a situation where science suggested that future practice would have radically different foundations – in the case of aircraft propulsion, surpassing the potential of functional piston engine and propeller systems. This resulted in the turbojet revolution. However, technological change did not cause large-scale organizational change since pre-existing firms continued to manufacture turbojets.[350]

Intriguingly it was believed in the fifties that jet engines were not suitable for long-range passenger planes as they had much larger fuel consumption than propeller planes. The Boeing 707 proved this assumption wrong and made jets popular in civil aviation. Toward the end of the 1950s aviation industry was producing such aircraft as the Boeing 707, Douglas DC-8, Convair 880/990, Comet IV, and the smaller medium range planes Bristol 200, and Caravelle. Most of these jets had four engines, flew at the speed of 500 miles per hour at 39,000 feet, and were able to carry 80 to 165 passengers. Related changes such as the introduction of high-octane fuels, modern radar, centralized data processing, regulations, and radio-communication stations for air traffic control (VOR), made aviation not only safer but also more efficient. Aircraft could no longer be viewed in isolation but as parts of a heterogeneous system involving (at least) airfields, terminals, air control, fuel depots and maintenance facilities, navigation and communication systems, and an interdisciplinary group of aviation professionals. In 1958, the Federal Aviation Agency (FAA) was established to regulate and advance aviation in the United States. International aviation was likewise regulated by the International Air transport Association (IATA), established in 1945. Rapid changes in the industry meant that airports had to be altered to meet these new requirements of aviation. Obviously then, the monumental “third-generation” airports were outdated and incapable of serving the industry.[351]

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[349] *Converted military planes included the B-29 Superfortress, which became Boeing’s B-377 Stratocruiser. Gordon 2004, 142, 157-158.*

[350] *Constant 1987, 226.*

[351] *IATA is the successor to the International Air Traffic Association established in Hague in 1919. In 1945 it had 57 members out of 31 countries, today 230 members from 126 nations, which demonstrates the astonishing development of the aviation industry. Bilstein 1984, 167-245;* Federal Aviation Agency's First Annual Report to the President and the Congress *1959.*

The postwar airport was an urban planning problem and IATA published several design manuals for airport planners. Larger and heavier four-engine aircraft types carried more people and demanded larger passenger and maintenance facilities, longer unobstructed approach and takeoff routes, and suitable runways. Jet engines created blast and noise problems in neighboring areas and interfered with television and radio broadcast. Furthermore, large aircraft flying over the immediate city centers created a real safety hazard, which became evident in the early fifties when several planes crashed in neighborhoods. Because of these noise, nuisance, and safety concerns, authorities recommended that airports be placed outside city centers (preferably by interstate highways) and surrounded by a sufficient safety buffer zone. Such locations were chosen for O'Hare along Interstate 90, Friendship Airport along the Baltimore-Washington Expressway, and New York International along the Van Wyck Expressway.[352]

At the same time Cold War fear of nuclear attacks on cities accelerated industrial dispersion and suburbanization especially in the United States. Suburbanization was driven by national policies to favor new home construction with subsidized mortgages, but, according to Peter Galison, postwar architectural dispersion was also based on the logic of aerial bombings. During the Second World War, Army Air Force's Committee of Operations Analysts had found interconnections between the German economy and the war machine and identified nodal points, which could paralyze the system. The effects of the bombings were analyzed by the United States Strategic Bombing Survey, which noticed that in response to the attacks on *Luftwaffe*, Germans dispersed factories in diverse suburban and country districts to protect the war machine. The conclusion was that aerial warfare was effective when directed against concentrated, centralized production at a functional node serving other industries. It failed if factories were dispersed. Thus separation and dispersal meant protection. This conclusion was confirmed in the studies made of the atomic attacks on Hiroshima and Nagasaki. Furthermore, the latter survey led the analysts to see parallels between the effects of the atomic attack in Japan and the threat of an attack in the United States. In the light of these surveys and in the context of the Russian atomic bomb and Korean War, a national policy of industrial dispersion was announced in August 1951. As Galison argues, this demonstrated that bombing the Axis economy and suburban dispersal of the American industry were reflections of one another. Gradually industries started to see themselves through the bombsight and sought exurban locations. This dispersal was reinforced by the postwar housing shortage, racial tensions, and the modernization plan for transportation infrastructure, which developed the Interstate and Defense Highway System to evacuate cities, circumferential roads to drain industry and population from centers, and interstate highways to bypass urban areas. Americans saw themselves as targets, and this reflected in the transformations of infrastructure, computation facilities, highways and factories.[353]

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[352] The Airport and its Neighbors *1952*; Airport Buildings and Aprons *1956;* Airport Design *1949;* Airport Terminal Buildings *1953;* Apron Requirements for Turbine-powered Aircraft *1958; Pietrasanta 1957, 11-18, 88.*

[353] *Galison 2003, 197-225.*

In the postwar political climate a logistical network of highways, railways and airports connecting cities, surrounding suburbia and dispersed industrial centers became the new urban planning ideal evident for instance in the plans of Ludwig Hilberseimer. Hilberseimer, whose town planning ideas were in part developed already in prewar Europe, published an image of Nagasaki before and after the bomb and claimed: "It is of greatest significance that modern defense requirements reinforce the tendency toward decentralization. Today, as always, military considerations will profoundly affect planning and military expedient will be from now on a driving force toward decentralization. Protection against aerial attacks can be achieved only through decentralization and the dispersal over the countryside of industrial and settlement concentrations. In the world of the atomic bomb, city concentrations can only be a preparation for man's suicide."[354]

Even though airports were part of the postwar transportation infrastructure, placing airports outside cities was not primarily a military concern but rather a question of space.[355] Location outside of immediate city structure allowed airports to grow with closer management of urban development around them. Yet, locating airports outside cities posed the problem of maintaining low-cost, efficient, and rapid connections with the city. Superhighways, rapid urban rail transit, and mainline rail service were proposed as solutions to the ground transportation problem. Eventually subway systems were extended to the airports in New York, Chicago, Paris and London among other cities, while many European airports were connected with rapid intercity railways. At the same time some downtown airports such as Washington National, which is still operational, and Berlin Tempelhof, which was closed down in 2009, survived until the twenty-first century. This also suggests that military concerns (although important) were not paramount to the placement of airports. The immediate surroundings of airports were gradually developed into airport cities, i.e. clusters of aviation related industries and businesses, hotel complexes, motels and conference centers creating important revenues for the airports. Thus, finding a balance between central and peripheral location was, and still remains, a challenge for airport planning.[356]

Airports serving jets had to have the airside façades of their terminal buildings covered by blast walls, and the status of practically every other building on the airfield was also questioned. Emphasis was placed on promoting the continuity of transportation (from one aircraft to another, from cars to airplanes) rather than providing monumental places to stop along the way. Passenger buildings shrank and became more functional, separated from service structures. Yet the question of how to move between the terminal and the aircraft remained unsolved. New aircraft required longer runways and their larger wingspan demanded greater distance between runways and taxiways. Parallel runways were built to

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[354] *Hilberseimer 1949, 70, 188-190; Hilberseimer 1955, 281-286.*

[355] *However, according to the FAA report, traffic control center buildings in Cleveland, Oakland, Jacksonville and Atlanta were constructed outside blast damage areas of any reasonable probable nuclear attack on major cities, and provided full protection against radioactive fallout.* Federal Aviation Agency's First Annual Report to the President and the Congress *1959, 10.*

[356] *Bouman 1996, 184-185. Easterling 1999; Twentieth Century Building Type 1953, 78. On the idea of the airport city see Bruegmann 1996, 195-211.*

meet the increase in air traffic and allow simultaneous takeoffs and landings. While the electrical and electronic equipment spread beyond the boundaries of the airport, radar and approach control equipment was placed in the surrounding countryside or wasteland, marking the lines of runways with what Banham called the "subtopian wirescape." [357] This contributed to making the airport a regional planning problem.

Postwar airports are classified as the "fourth, fifth, and sixth generation" of modern airports.[358] However, classification according to generations is neither critical of the technological evolution taking the form of a development trajectory, nor very informative unless airports are first described based on their spatial and functional organization. Therefore, to clarify the confusion in airport typology, it is best to start with differentiating between the centralized and the decentralized airport terminals. The basic difference between the centralized and the decentralized airport terminal type is that in the centralized model, airline counters, waiting areas and baggage handling are gathered in the main section of the terminal, whereas in the decentralized model a series of separate but interconnected units or satellites serve one or few airlines. While the former system facilitates central management and transfers between airlines, the latter is often favored by airlines as it allows individualized customer service and encourages travel with a single airline. In addition airport terminals are defined based on their operational system as pier finger terminal, satellite terminal, and gate arrival terminal (also called the frontal system or the open apron system). The advantages and disadvantages associated with these various operational systems were increasingly discussed in planning manuals and other professional literature in the fifties.[359]

In my view, the "fourth- generation" airport denotes the centralized gate arrival or finger terminal of the forties and fifties, the "fifth-generation" airport refers to the decentralized satellite terminal of the sixties, and the "sixth-generation" airport is the typical airport terminal of the seventies, when safety concerns resulted in the separation of open and secure areas. These generations in turn developed as responses to the demands of first, mass transit and the jet aircraft (introduced to commercial service in 1958), second, the jumbo-jet (which entered service in 1969) and third, deregulation and the threat of terrorism in the 1970s.

Most airport terminals of the forties and early fifties were "fourth-generation" centralized gate arrival terminals. In these, passengers walked from the gate to the aircraft parked on the apron. As traffic increased and distances grew longer, airports provided shuttle service between the apron and the terminal. Bus systems were first introduced at

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[357] *Banham 1962b, 252-253.*

[358] *See for instance Bosma 1996.*

[359] Apron Requirements for Turbine-Powered Aircraft *published by IATA updated the apron requirements set out by IATA for piston aircraft and described the characteristics of jet aircraft. Architectural magazines were also important in educating architects about airport requirements and design options. See also Thomas E. Greacen's chapter on airports and Albert F. Heino's chapter on air stations in* Forms and Functions of Twentieth Century Architecture. Apron Requirements for Turbine-Powered Aircraft *1958, 14-26;* Airport Terminal Buildings *1953, 12-16; Greacen 1952, 475-506; Heino 1952, 405-547; Jet Airports 1960, 167-182; Twentieth Century Building Type 1953, 87-89.*

Amsterdam-Schiphol and thereafter at several other European airports. When jet aircraft entered commercial service in 1958, blast and noise made walking on the apron impossible. The mobile lounge system at Dulles Airport is a solution to this problem and a more sophisticated version of a centralized gate arrival terminal. Gradually, increase in air traffic and demand for more aircraft parking positions led to the addition of corridors to existing gate terminals. The growing volume of travelers required also larger facilities with better services. More functional and spatial models were thus increasingly sought for the complex building program.[360]

Another type of the "fourth-generation" airport, the finger terminal, connected with the aircraft by fingerlike, extendable and adjustable gangways that allowed same-level boarding. Some of the early fingers were simple fenced passenger walkways, such as Saarinen used at the Athens International Airport, which is a centralized open finger terminal. Later gangplanks took the form of elevated ramps reaching from the terminal (or pier finger) to the aircraft passenger door.[361] Fingers could be arranged in several ways, but most fingers were attached to simple linear, T-shaped or Y-shaped concourses. In this type of terminal passengers moved from a central area into separated arrival and departure lounges, located close to the aircraft that was standing next to the pier. Boarding piers stretched out of the terminal in convenient intervals to accommodate more airplanes, and were further extended by adjustable gangways i.e. jetways to enable same-level boarding when jets taxied to the gate. The first European finger type terminal was London Gatwick's second terminal (1958, Yorke, Rosenberg and Mardall), which was a rectangular building with one finger glad in steel-and-glass curtain wall. The finger system was a practical way to expand existing airports and therefore it was quickly adopted for Milan-Linate, Copenhagen-Kastrup and Amsterdam-Schiphol.

Chicago O'Hare airport, designed by C. F. Murphy Associates in 1957-1963 in collaboration with the airport consulting firm Landrum and Brown, is an excellent example of a finger terminal (fig. 4.21 and 4.22). O'Hare Airport's master plan had already been prepared in 1948 by city engineer Ralph Burke, and construction begun in 1949, but by 1956 the original scheme was insufficient for anticipated traffic and new architects were hired to revise the earlier design. In the new scheme a dual-level roadway led to the terminal and separated enplaning and deplaning passengers into different levels of the building. In addition the airport was served by a light-rail connection to the city center. Originally the airport had three finger terminals constructed with black steel and grey glass, and connected by a round restaurant building of reinforced concrete with a cable-suspended roof. Each building had fingers extending to the apron. The interiors featured tandem sling seating, which was designed by Charles Eames and produced by Herman Miller Company. This seating, which has been in production since 1962, became a design classic that has been adapted to several airports including Dulles International. Several buildings, including the United Terminal by Murphy/Jahn have since been added

[360] *Bosma 1996, 53-54.*

[361] Apron Requirements for Turbine-Powered Aircraft *1958, 54.*

to the airport scheme, but the original terminals still maintain their elegant form and appearance.[362]

Gradually passenger buildings and car parks became concentrated in the central section of the airport and access to them was provided through an underpass or an overpass. Runways were grouped in constellations or arranged tangentially around the terminal. The airport thus became completely independent of its surroundings.[363] Heathrow Airport (opened in 1946) is a prime example of an expanding airport within a formal runway constellation. Heathrow's original design by Frederick Gibberd (1947) consisted of a terminal and a control tower in the middle of the existing military runway layout in the shape of the Star of David. However, throughout Heathrow's operational life, alternative locations have been sought for a major international airport serving London. Rationalization of London's airport system was proposed already in 1953, since the seven airports operating in the region at the time threatened coherent air traffic control. As a result Heathrow was designated as the single main international airport, with a principal backup of Gatwick and a third facility in reserve. An old military airfield of Stansted would have been an ideal site for the third international airport, but neighborhood opposition prevented its development already in the fifties. As Elliot J. Feldman argues, plans for the third international airport in London failed because political power oscillated between the Conservative and Labour parties causing constant changes in government policies. As plans for the third airport never materialized, expanding air traffic was served by adding new buildings at Heathrow. These included a control tower, an administrative building, a short-haul terminal (terminal 2, opened in 1955), a long-haul terminal (terminal 3, opened in 1962) and a domestic terminal (opened in 1969). Connections between these finger terminals were provided with bus service. In the 1960s cargo-handling and maintenance areas were established in the southern and eastern boundaries and in 1977 the airport was connected to the London Underground network. The newest addition to the airport is the terminal designed by Norman Foster and opened in 2008. All these developments were constrained within the original runway layout.[364]

Some postwar airports developed into "fifth generation" decentralized satellite configurations that aimed to take aircraft maneuverability to the extreme. This was important, since it resulted in faster turn-around times and greater profits. In the satellite terminal configuration concourses and tunnels connected main terminals to separate satellite buildings on the apron. Aircraft were parked around the satellites and accessed through gates. Centralized passenger handling was abolished in order to reduce walking distance between parking lots and the airplane. This type of airport was also called the drive-in airport, since parking was often provided on the upper floors of circular terminal buildings such as Toronto's Lester B. Pearson International Airport, Terminal 1 (1961-64 by John B. Parkin). The extreme high-tech version of a circular terminal with access roads leading to parking facilities on the upper floors, space age aesthetics, escalator tubes connecting different levels in the core of the building, and satellites utilized for boarding

[362] *Brodherson 1996, 84; Jet Airports 1960, 170-172.*

[363] *Bosma 1996, 52-54.*

[364] *Feldman 1985, 52-75; Pascoe 2001, 82-87.*

the plane was Terminal 1 and its satellites at Paris Charles the Gaulle International Airport in Roissy-en-France (often called Roissy 1), designed by Paul Andreu and the Aéroports de Paris architects between 1967 and 1974. This machine for serving the aircraft was the culmination of the so-called "fifth-generation airports."[365]

The difference between the "fourth and fifth generations" of airports is best understood when Paris Orly, which is a centralized gate arrival terminal, is compared with Paris Roissy 1. Orly's curtain-walled, rectangular, 660 feet long, 230 feet wide, and eight-story high, terminal was designed by Aéroports de Paris and Henri Vicariot in 1961 (fig. 4.23). It was later extended in the east and west sides with two-story fingers extending the width of the airside façade into 2300 feet. Situated only seven miles south of Paris it became a popular tourist attraction. The minimalist, transparent terminal portrayed European modernity and did not only serve travelers but also visitors and weekenders. Visitors intrigued by aviation, Orly's modernity, and consumer culture were accommodated with a cinema, several hotels, exhibition space, a Michelin-starred restaurant, a chapel, several coffee bars, and an observation terrace.[366] Orly and other such postwar showcase airports like London Heathrow and New York International Airport were popular weekend destinations. People came to have dinner in panorama restaurants overlooking the airfield and enjoy the atmosphere in one of the most modern environments imaginable in the fifties and sixties.[367]

However, as a result of the rapid development of aviation industry Aéroport de Paris, the manager of airports within a fifty-kilometer radius from Paris' Notre Dame Cathedral, claimed already in the fifties that Orly and le Bourget could not be expanded because of urban encroachment and noise nuisance. Instead it was concluded that Paris needed a third airport. Therefore site selection for the third airport began already when Orly was under construction (1954-1961), and the site in Roissy-en-France was selected in 1957. Roissy 1 (originally called Aéroport de Paris Nord) was the absolute opposite of Orly. It condensed airport services into a minimal space of a single terminal. Aéroport de Paris and Paul Andreau designed the airport in its totality including the roads, the terminal building and its satellites, and the air traffic control tower (fig. 4.24).

Roissy 1 was specifically designed for the wide-bodied Boeing 747, which was designed in 1965 and entered commercial service in 1969, and the Concorde that had its first flight in 1969 and entered service in 1976. First, the jumbo jet with its wingspan of nearly 200 feet, takeoff weight of over three-quarter of a million pounds, and seating capacity up to 550 passengers and then, Concorde with its wingspan and demand for longer runways removed from populated areas, set new requirements for the airfield and its facilities. Concorde's wingspan made it almost impossible for fingers to reach out from the terminal to the plane's door and thus the plane had to be reached through a satellite system, where passengers passed underground to a mini-terminal for actual embarkation to the plane parked on the apron. The terminal was a hollow-centered, nine-story, cylinder-shaped building surrounded by satellites, which could simultaneously serve four wide-

[365] *Bosma 1996, 54; Jet Airports 1960, 170-172.*

[366] *Pascoe 2001, 54-55.*

[367] *Zukowski 1996, 15.*

bodied jets. In the middle of the cylinder building, transparent tubes housing mechanized belts for moving passengers and goods connected services, which were separated on different floors. Passengers drove into the building and parked their vehicles on the upper floors and the rooftop. They then took one of the escalators crossing the empty core of the terminal into the check-in floor, and walked through a tunnel into one of the seven satellites functioning as departure lounges.

Roissy 1 was expected to be the busiest in continental Europe and to symbolize French creativity, imagination, prestige and national unity. However, the traffic forecast was flawed as it did not allow for any growth in aircraft size and instead assumed that the number of planes was directly proportionate to increase in the number of passengers. Consequently, in 1974, Orly and Roissy 1 operated at about 60 percent of their capacity with the latter only in its first development phase. Furthermore, Roissy 1 suffered from insufficient connections to Paris until its underground, railway and bus connections were developed into a functional ground transportation system. In fact, Elliot Feldman claims that Aéroport de Paris had preferred automobile access, which created considerable parking revenues even when it was acknowledged that the only existing access road, Autoroute du Nord was already heavily congested. Other major, and surprising conceptual and technical problems in the design process included over purchase of land, excess capacity, troubled neighbors, inefficient access, insufficient traffic distribution, and air conflict with le Bourget. Hence, Feldman calls Charles de Gaulle Airport a white elephant: it was rationalized as a response to traffic forecast and the technological requirements of supersonic flight, but built as a monument to technical hubris and uncoordinated central planning.[368]

While Roissy 1 evoked the exiting space age imagery of the late sixties it had some serious faults including the high cost of running the tubular walkways and moving sidewalks, and the lengthy one-way circulation pattern of aircraft around the terminal. For airlines the terminal was too clever and expensive to operate as the satellite system imposed an unusual financial burden on airlines: it required personnel in two separate locations. Ground time circling the one-way terminal was more than double the ground time at Orly and the distribution of traffic between Orly and Roissy 1 was illogical. The cost of running the airport was also high because of inefficient planning that for instance involved moving baggage up six stories on arrival. Electricity bills for moving ramps and rechargeable robots grew continually while standing areas and immigration facilities were inadequate for the passengers of fully loaded wide-body jets. Furthermore, the circular terminal could not be extended and thus a new Terminal 2 was designed by Andreau and constructed in phases between 1972 and 1994. This linear structure formed ellipses linked by a service road and repeated the elliptical theme in its concrete façades. The development of the airports serving Paris, from le Bourget to Orly and Charles de Gaulle International Airport then demonstrates not only the ambitions and difficulties, but also the politics, and economics involved in the construction of airport terminals.[369]

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[368] *Feldman 1985, 19-47; Lockhart 1996, 222.*

[369] *Feldman 1985, 29-47*; Building for Air Travel *1996, 150-151; Javault 1997 (1991), 137-138.*

Postwar airport designers paid special attention to all scales of the airport. Architects, for instance, developed special seating arrangements, chairs, benches, and tables for terminal interiors or utilized seating by companies such as Herman Miller Company and Knoll Group. Eero Saarinen was known to design his airports as total projects comprising not only the architecture but also the furniture and even minute details such as ashtrays. This was especially the case of the TWA Terminal. On the larger scale, the air traffic tower was developed into a special building in the postwar era and it received its own architectural treatment, which is best exemplified by FAA's standardized air traffic tower, designed by I. M. Pei for O'Hare Airport between 1966 and 1971. Structurally impressive, undivided terminal interiors and hangars were also created utilizing thin shell concrete structures and cantilevers. Especially noteworthy was the revolutionary reinforced thin shell concrete structure for American Airlines hangars (1948) and TWA hangars (1953) at the Midway Airport in Chicago designed by the architect Aymar Embury II together with Charles Whitney, a pioneering concrete specialists and partner in the engineering firm Ammann & Whitney.[370]

The first terminal building to use thin shell construction was Lambert St. Louis International Airport terminal, designed by Hellmuth, Yamasaki and Leinweber and opened in 1956 (fig. 4.25). Its innovative structure elaborated a series of cross vaults and this use of vaulted structures made it a predecessor of the TWA Terminal. The Lambert St. Louis terminal took advantage of the newest construction techniques and was designed to give an appropriate expression to a modern airport terminal. It had a large passenger concourse formed by three cross vaults atop a rectangular service floor. Heat resistant glass panels between the vaults provided views of the airfield and the approaching aircraft. Three fingers extended from the main concourse toward the apron, and the terminal was to be extended by adding vaults at the east and west ends of the building. The St. Louis Airport set an architecturally impressive model to meet the constantly growing spatial requirements for terminals. Unfortunately, the intended method of extension was abandoned after 1967 due to the rising cost of thin shell construction.[371]

New York International Airport, or Idlewild as it was called before it was renamed John F. Kennedy International Airport in 1963, is a good example of another postwar development in airport planning –the airport city, which consists of various terminals and service buildings at the center of the airport (fig. 4.26). The building process of Idlewild was a long one and lasted from 1941 to 1971. It was initiated when New York City purchased the former golf course on the eastern edge of Jamaica Bay, filled and stabilized the land between 1941 and 1945. During the prolonged planning process several architects including Gilmore Clarke, Delano and Aldrich, and Wallace Harrison were involved in the design. After extensive negotiations between Robert Moses of City Airport Authority and Austin Tobin of Port of New York Authority, the airport was leased to the latter to operate for fifty years in 1947. The first terminal building was constructed according to the Delano and Aldrich plan of 1945, but in 1952 Wallace K. Harrison of Harrison and Abramovitz

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[370] *Brodherson 1996, 81-83.*

[371] *Architect Edgardo Contini and civil engineers William C. E. Becker and Anton Tedesko were consulted for the creating of the thin shell dome design. Brodherson 1996, 85; Gordon 2004, 181-182.*

together with Thomas S. Sullivan, Director of Aviation Planning revised it. The new master plan formed a terminal city, which consisted of nine unit terminals, an air traffic control tower, parking lots, heating and ventilating and air-conditioning plants, aircraft maintenance hangars and cargo facilities, a charter airline terminal, a bank, a general aviation terminal, a car service station, a hotel, and a vast landscaped plaza.

The unit terminal concept, which was developed by architect Albert F. Heino already in 1945, contained all necessary functions such as check-in, handling, waiting, concessions, and maintenance in one terminal.[372] This type of a terminal with its limited number of connections reduced the distance from the entrance to the aircraft. Furthermore, at Idlewild most unit terminals were operated by individual airlines, which allowed them to employ architects of their choice to design spectacular buildings and showcase the airline. Decentralized unit terminals, such as the TWA Terminal, which was also a satellite terminal, could function as signature buildings for their airlines.

The first terminal in the new Idlewild scheme was the International Arrivals Building, which served fourteen foreign carriers. This sophisticated, International Style building was opened in 1957 and designed by J. Walter Severinghaus, Charles E. Hughes and Albert Kennerly of Skidmore, Owings and Merrill. A steel-frame parabolic arch connected the low terminal building and the control tower glad in steel-and-glass curtain walls. Harrison designed the elevated pedestrian walkway leading from the building complex to a large landscaped mall and the main arrivals building. The more flamboyant individual airline terminals at Idlewild included the Pan American Airways Terminal by Walter Prokosch of Tippetts-Abbett-McCarthy-Stratton (1960, renovated 1970). The Pan Am Terminal, also known as the Worldport, was an elliptical structure hovering over thirty-two concrete piers. Jets such as the Boeing 707 "Clipper" would taxi under its magnificent roof for boarding. Other features included skylights and a panorama restaurant. I. M. Pei's National Airlines Terminal (1971) was the last terminal in the original scheme. Its elegantly minimalist structure utilized glass mullions for the first time in the United States. Idlewild's terminals were linked by a looping access road, and connected to the city by the congested Van Wyck Expressway. Surprisingly, the airport was not connected to the subway or the Long Island Railroad. The "Airtrain" rapid transit system connecting the terminals and providing access to regional commuter trains and subway was only constructed between 1998 and 2003.[373]

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[372] *Heino 1945, 80-82.*

[373] *The terminals at JFK have since gone through extensive alterations and several terminal buildings have been demolished altogether. The International Arrivals Building was replaced by a new SOM design in 1997-2001. Harrison's landscape was destroyed to a large extent, and the Jewish chapel (Bloch & Hesse, 1966), Protestant chapel (Edgar Tafel & Associates, 1966) and the Catholic chapel (George J. Sole, 1966) on Tri-Faith Chapels Plaza demolished. Kahn and Jacobs' American Airlines Terminal (1960) and SOM's United Airlines Terminal (1959) were demolished in 2007 for the construction of a new American Airlines Terminal. Saarinen's TWA Terminal's satellites were demolished and its overall appearance largely compromised with the building of a new Jet Blue Terminal in 2008. Pei's terminal was also demolished so that the Jet Blue Terminal could expand. Brodherson 1996, 85-88; Gordon 2004, 186-204; Hunt 1961, 152-156; Mellins 2005.*

By the sixties airports were facing organizational problems and approached what the editors of *The Architectural Review* called the “Landscape of hysteria” in a series of articles including Reyner Banham’s “The Obsolescent Airport.” They specifically referred to Idlewild Airport and its mixture of service roads, car parks and blast screens, which made the original Beaux-Arts diagram arbitrary and irrelevant. The other exemplar of this landscape was the marginal subtopia of functional equipment found on the outskirts of Heathrow. Airports had become cities in the outskirts of cities, separated from them by a barrier of wasteland scattered with strange functional equipment, service roads, hangars and car parks. These airports inspired Banham to claim: “the grandeurs and miseries of this moment of grotesque fulfillment, in which an airport explodes into a regional planning problem, have been monumentalized in London Airport, Orly, Leonardo da Vinci and, par excellence, at Idlewild with its pointless Marienbad Allée in the middle of a spaghetti of roadways and a fairground of competing terminal buildings.”[374] Such interpretation also resonates with Victor Gruen’s critical concept of “transportationscape,” which he defined as the cityscape of highways, freeways, expressways, parking lots, cloverleaves and traffic signs, power lines, airplane runways and railroad yards. Surrounded by the technoscape of high voltage lines, oil wells and chimneys such a landscape connected suburscapes of housing and left in-between the subcityscape of gas stations, shacks, car lots, posters, billboards, roadside stands, rubbish, dirt and trash –in effect the worst of the modern cityscape.[375]

The sixties were a decade of hybrid postwar airport structures. Different airport terminal types were employed according to the anticipated volumes of traffic and aircraft operations. While small airports were built in remote locations, central airports in the United States grew into complex megastructures i.e. extendable matrixes of modular units serving wide-bodied jumbo-jets. Many of them remained incomplete as the slow-down of airline business led to the completion of only the first phase of a multiunit plan. Banham classifies as megastructures the partially realized Boston Logan International Airport (John Carl Warnecke, 1967), Houston International Airport (Pierce and Pierce, 1961 onwards) and Dallas-Fort Worth International Airport (DFW by Hellmuth, Obata and Kassabaum, 1965-73, fig. 4.27). Houston International had a series of square terminals connected to four satellite buildings with elevated walkways and highways running below them. At Dallas-Fort Worth Airport railways and multiple expressways connected the massive terminal loops.[376] Banham predicted Dallas-Fort Worth to be the end of development triggered by wide-bodied jumbo-jets, but in hindsight it is evident that DWF became a model for the light rail systems or airtrains that organize and connect most contemporary airport structures: for instance at JFK, Newark, and San Francisco International (International Arrivals Building and light rail system, SOM, 1993-99). DFW also influenced the organization of subsequent airports such as Terminal 2 at Charles de

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[374] *Banham 1962b, 252-253.*

[375] *Gruen 1993 (1955), 194-199.*

[376] *Banham 1976, 179-182.*

Gaulle, and Rio de Janeiro International Airport (Hidroservice Engenharia de Projetos Limitida, architects, 1974-90).[377]

From the seventies onward airport planning became increasingly international and impressive, culturally diverse modern airports such as Haj Terminal at King Abdul Aziz International Airport in Jeddah, Saudi Arabia (SOM 1976-78) emerged in geographically varied locations. This development followed globalization, the shift in international business to emerging markets, and the subsequent construction of large aviation hubs in new locations.[378] While the 1970s fall outside the scope of this study, it is necessary to mention that international terrorism of the seventies changed airport planning radically. In the so-called "sixth-generation" airports safety was a major issue around which everything else was arranged. It was no longer possible to maintain the concept of the least distance between the terminal entrance and the aircraft. Instead open and secure areas became separated within centralized departure and arrival halls. Security screenings were introduced at the airports and spectators restricted to observation areas.

Security measures meant that people spent more time at the airport prior to takeoff and therefore the 1980s and 1990s saw an increase in retail facilities and an emphasis on the identity of the airport terminal as a place where people actually spent a significant amount of time waiting for departure or transfer. Consequently terminals developed into large concourses of exposed structure and became showcases for retail and culture. The new Washington National terminal designed by Cesar Pelli and Associates in 1990-1997 is an excellent example of an arcade type of terminal intended for shopping while seeing off travelers or waiting for one's flight. Another re-found inspiration for the airport was the hangar with its vast space and exposed structure. Attention focused on the ceiling as the fifth façade most noticeable in otherwise architecturally neutral, vast spaces. The exposed structure received its own architectural expression. In a way, airport terminals once again resembled the building types that had influenced their development –the railway station, the shopping mall (arcades) and the structural hangars.[379]

4.4. The Airport Terminal in Air Route Networks

The airport terminal is an emergent building type of the twentieth century and its typology evolved in parallel with the institutionalization of modern architecture. Yet the exceedingly modern airport terminal constitutes a blind spot in most accounts of the rise of architectural modernism. It was technologically too modern and stylistically not modern enough to be recognized by the historians of the modern movement. Instead, historians centered on the idea of a "new tradition" and emphasized architecture that translated existing building types into the modernist idiom. This changed only after the

[377] *DFW incorporated some interesting landscape and artistic ideas that emerged from Robert Smithson's artistic survey and compliment the overall structure of the airport.* Building for Air Travel *1996, 146-149; Pascoe 2001, 92-97.*

[378] Building for Air Travel *1996, 173.*

[379] *Bosma 1996, 57-60.*

sixties when the typology of the terminal building stabilized sufficiently to suggest criteria for the evaluation of technologically advanced *and* aesthetically modern terminals. Postwar terminals were not only functional airport architecture but designed by second-generation modernists along the (often International Style) modernist idiom.

As Banham argues, new building types such as the railway station, the elementary school, the medical hospital, the elevator office block and the modern dwelling were factually employed to justify a "new tradition" in the discourses of modernism. Yet, in the case of some new building types (such as the atomic power station) only a few magnificent examples existed as fast scientific and technological development made these buildings obsolete by the time of their completion. Typically these new building types – including the airport terminal –also emphasized utilitarian building and functional improvement over spectacular form giving.[380] Each architect designing an airport terminal had to balance between aviation technology and modern aesthetics. Advances in aircraft technology, however, did not determine the aesthetics of the terminal building, but were rather incorporated in its functionality.

Indeed, in terms of airport architecture, function (or functional) is the most relevant term in the vocabulary of modern architecture. Functional, which in the discourses of architectural modernism became synonymous with modern, was actually derived from three German words: *sachlich, zweckmässig* and *funktionell*. As a condition of art, *Sachlichkeit* ('thingness') referred to the aesthetics of ornament free, rational, scientific, and modern construction. *Zweckmässigkeit*, on the other hand, referred to the purpose (*Zweck*) of the object and its inner organic meaning or function. Significantly it did not imply the constructional rationalism or mechanics of structure developed in modern engineering (*Realismus* in German), but was rather the rational expression of the use (function) of the object. *Funktionell* (functional) described the effect of action, and in particular, the interrelations of the parts and the overall structure. Function thus signified the inner idea of an object that defined its organic shape, in the same manner as Louis Sullivan's "form follows function" emphasized function as metaphysical organic form. But functional never had an overreaching theory and it were rather the histories of modern architecture that made it synonymous with modern.[381]

Regarding the airport terminal "functional" had all the above connotations. While the functional success of an airport was relatively easily measured by the ease, speed and efficiency with which it handled traffic flows, the appropriate architectural expression of a functional airport was much harder to define.[382] In some buildings functional meant the aesthetics of ornament free, rational modern construction, in others the rational expression of the use of the building as a transportation hub or terminal station. The functionality of the airport infrastructure was measured by the interrelations of the parts to the overall structure as this resulted in free circulation of passengers, goods and aircraft, and quick turnaround times. It was only in the fifties that the airports became complex industrial enterprises facilitating interchange between air and surface transportation in an

[380] *Banham 1975, 18, 25.*

[381] *Forty 2000, 174-195.*

[382] *Bosma 1996, 52.*

arrangement, where the airfield consisted of the apron, the runways, the taxiways, and the terminal building. But the airport is not just infrastructure. Rather it is an organic entity adapting pre-existing infrastructure into the requirements set by new technologies, economic trends, and social dynamics[383]. It incorporates functionally diverse space (reserved for ticketing, security, immigration and traveler's services) and transit zones (for fuel, food, cargo, baggage, and planes) into an architectural entity.

Aesthetically speaking the airport is not unlike other modern building types since the majority of twentieth century architecture was not modern, but rather traditional. Even buildings that looked stylistically "modern" were often not constructed with modern materials and construction techniques due to building regulations and financial constrains restricting their realization.[384] In fact, traditionalism was superseded by modernism in several countries and building types only after the Second World War.[385] The airport terminal was no exception and International Style modernism prevailed in airport architecture only after the war. However, modernist tendencies were always visible in the short history of the building type. Therefore some of the airport terminals discussed above (such as Stockholm-Bromma or Copenhagen-Kastrup) could have easily been included in the histories of modern architecture had they been analyzed in relation to period architecture, while others (such as Roosenburg's Schiphol Airport) suggest the canon be expanded to include previously neglected variants of modernism.

A close study of the typological instability of the airport terminal –which exposes its alternative development trajectories and a plurality of technological possibilities – questions techno-determinism inherent in the narrative of official architectural modernism. In this sense the airport terminal "uninvents" modern architecture. Histories of modern architecture shared a determinist belief in the evolution of technology as a logical and unquestionable process guided by rational selection. Yet in reality this selection was shaped by many factors including socio-economic processes, politics, culture, and chance.[386] Therefore, the technological evolution trajectory imagined by the modern machine utopia did not exist. Neither did architectural modernism, nor the typology of the airport terminal evolve logically along a linear development pattern. Among other factors, institutions involved in the planning –and specifically their socio-economic interests – were decisive factors in the development of certain aircraft technologies and terminal typologies. The typological development of the airport terminal was a result of the networks producing it.

Science and Technology Studies scholar Madeleine Akrich proposes a method of "de-scription" to analyze the relation between the form and meaning of a technical object – such as the aircraft or the airport, understood as a large technological system. According to Akrich design involves a hypothesis about the entities that make up the world, assumes a technological trajectory, and defines actors with specific competence and motives. This vision is inscribed in the technical object and negotiated between the inventor, and the

[383] *Pascoe 2001, 11, 14.*

[384] *Banham 1975, 30-34, 40, 43.*

[385] *Hitchcock 1987 (1958), 530, 531.*

[386] *MacKenzie 1990; MacKenzie 1996.*

assumed and the real user. This is why it makes sense to say that technical objects have political strength: they stabilize, naturalize, depoliticize, and translate social relations. In other words, they imagine and produce users. After a certain technology is accepted, the processes involved in its construction are concealed and the causal links it established naturalized. Akrich discusses technological transfers between developed and developing areas, but this type of analysis is equally descriptive when one thinks about an emergent building type. The typology of the airport terminal evolved through negotiations between imagined and actual users, and involved knowledge transfers between designers in various geographical locations. It is in this sense that the airport terminal, along the aircraft, imagined and produced the modern traveler.[387]

Yet history seldom discusses how objects construct or alter subjects and other objects. Instead, this history is traced in silent physical reminders such as pumps and stones, technical devices, and forgotten objects. Objects shaping architecture do not have a role; they hardly exist in architectural history.[388] Nothing of the aircraft or air routes remains in the history of modern architecture and hence it seems that only men, not the aircraft, shaped the architecture of the airport and its terminal building. But if air routes are defined as a technological network similar to gas lines, sewage pipes, railroad tracks, electricity networks, and telephone lines, they appear as architecture branching across space. To follow Latour's thinking air route networks are not unlike "nets thrown over spaces and retaining only a few scattered elements of those spaces. They are connected lines, not surfaces."[389] Hence, air route networks are not comprehensive, global or systematic even though they are laid over mapped surfaces and extend over long distances. Instead, each connection is a transfer and each movement in the network documentable. Airport terminals form nodes in these networks and function as points of transfer.

The network of airport architecture and air routes redefined the modern world and society. Without the aircraft it would not have been possible to win World Wars, transport food and people and goods swiftly to remote places, bring cultures together, or create global networks. The aircraft transformed architecture because it redefined distance, produced a new building type, introduced the air view, and altered the way cities and traffic networks are laid out. It remapped the world into a network of locations defined by the range of the aircraft and the location's relative importance as an international hub. Hence, the aircraft was a nonhuman *actant* expanding its network in a process that misplaced and translated other *actants*.[390] Airport architecture was constructed in a network including but not limited to the laws of nature, aircraft and other technologies, materials, the imagined and real users of the airport, and architecture's discursive practices. Hence, the airport terminal is simultaneously a material object, a social object, and a discursive object, a hybrid of sorts.

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[387] *Akrich 1992, 205-222.*

[388] *Latour 1993 (1991), 82.*

[389] *Latour 1993 (1991), 118.*

[390] *John Law writes about sea routes as traffic networks seen as actor-networks in a similar manner in Law 1987, 111-134. See also Law 2002.*

Because of aviation, people imagined the world and themselves differently. The airport terminal imagined –and actively produced –the modernity of the international community of travelers moving within the network of air routes. But the sleek lines of curtain-walled glass towers heralded in the dominant discourses of architectural modernisms did not have anything to do with aerodynamics and aviation. The intermingling of interior and exterior space through the transparent curtain wall was a far cry from the movement of an aircraft through clouds, its takeoff or landing on the runway, the taxiing of the machine to the gate and the circulation of passengers in carefully orchestrated sequences through the gangways into the terminal, customs clearance, luggage claim and ground transportation. The organization of the terminal space incorporated the machine, the luggage and the traveler and melted various nationalities and ethnicities into a uniquely international, modern experience. The airport terminal expressed a modernity experienced by an individual profoundly altered within the specific processes of modernization. These included technological advancements shrinking time and distance, migrations enabled by modern transportation infrastructure and the international networks of travel. It embodied the modernity of the air age and celebrated its transitory and nomadic nature.

5. Eero Saarinen's Laboratory for a New Architecture

In the previous chapters I have analyzed the genealogies of architectural modernism and the airport terminal. This chapter, in turn, analyzes Eero Saarinen's practice as a design laboratory for a new architecture. I describe how his office was reorganized to mirror the postwar corporate laboratories he was designing, and how his office approached the airport terminal as a scientific design problem. Furthermore, I demonstrate how these airport terminals were constructed within the heterogeneous networks involving various actors and *actants* with their social, cultural, economic and political interests. With his terminal buildings Saarinen redefined the modern airport. But what would be different had Saarinen not constructed three airport terminals?[391] And why were Saarinen's terminal buildings noticed in the histories of modern architecture?

Saarinen's practice, with its specific working methods, could be described as a design laboratory, in which the airport design problem was carefully defined, studied, and solved. I base this view on Science and Technology Studies and especially Bruno Latour, who defines the laboratory as the specific place where scientists work with their instruments. These instruments, in turn, he describes as devices that provide a visual display of any sort in a scientific text. Latour's definition does not presuppose material. Hence, textual accounts or architectural designs can be understood as laboratories of scientific experiments and trials. Furthermore, Latour claims that any scientist of any field equipped with a pen and paper, and presenting his results in a graph is using a scientific instrument and taking his laboratory with him to study his subject.[392]

Saarinen's office approached the airport design problem in a scientific manner. The key question the Saarinen office aimed to solve was how to spatially organize the airport in an efficient manner? In order to solve the problem more specific questions were asked: What kind of movement patterns did travelers and aircraft and luggage create in existing facilities? How long did it take to enplane and deplane? How were check-in, luggage circulation and concessions organized? How were the aircraft served and what kinds of services were required? What kind of layout for runways was most efficient? What were the current design ideals discussed in airport design manuals and architectural journals? How could a functional airport be defined? In order to answer these questions Saarinen's studio conducted field studies collecting data on already existing and functioning airports. Teams of architects, equipped with stopwatches, notepads and pens, were sent out on airports to carefully document how the organizational layouts of the airports performed. They timed enplaning and deplaning, drew circulation patterns, identified and described the key processes. The information thus collected was organized into charts and analyzed. Simultaneously architects in the studio traced the evolution of the building type and

[391] *This is a question asked by Donald MacKenzie of nuclear weapons laboratories. Mackenzie 1996b, 99-129, especially 126.*

[392] *Latour 2005, 127, 149; Latour 1987, 68-69.*

identified several "types" of airports. This evolutionary pattern was illustrated on diagrams.[393]

The problem was then taken on a different level. The question was reformulated and it was now asked what kind of form would be most suitable for the airport? In order to find an answer, the architects manipulated their data and experimented with design alternatives. They used modeling to arrive at an ideal aesthetic form. Based on the research the studio proposed a novel structural solution to the building problem, one that would functionally and economically reorganize the airport in the most efficient manner and yet artistically express an impressive and essentially modern architectural vision. The project was presented with diagrams in an effort to persuade the client of the proposed design. The information collected thus served the purpose of selling the architectural vision, and even though research was initially carried out for the design of the Trans World Airlines Terminal, subsequent designs for Dulles International Airport and Athens International Airport benefited from the database and the continuous research effort. To ensure public acceptance of his designs, the Saarinen office had teams to produce alternative designs and a public relations professional to enforce the desired image.[394] Saarinen thus managed to find support for his practice and enforce the image of a user he imagined.[395] Furthermore, he succeeded in convincing others to become the users his architecture imagined.

The design processes carried out in the Saarinen studio were surprisingly similar to Latour's description of Louis Pasteur's laboratory. According to Latour, Pasteur and his bacteriologists took their essential laboratory tools to the field to collect data and specimen, which were then transported back to the laboratory. In the laboratory they manipulated and experimented with the data until a scientific discovery was made. The material thus transformed and displaced was subsequently taken back to the field, where certain essential parts and practices were reorganized into a laboratory-like life-size theater of proof. What was of importance in this process that Latour calls the trials of

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[393] *Airport case studies, analysis and research, box 460, folders 1288-1301. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[394] *An important figure in Saarinen's public relations strategy was his second wife Aline B. Louchheim, whom he married in 1954 and who had previously worked as a journalist and associate art critic for the* New York Times *from 1947 to 1959. She also authored the book* Proud Possessors *(1958). After Saarinen's death she became a successful television talk show host. She assisted Saarinen in press relations and had extensive contacts in the media world. Her professionalism assured that Saarinen's architectural projects were covered in the professional media and even popular magazines such as* Harper's Bazaar, Look, *and* Vogue. *Boyd 1959, 40-48; Saarinen, Aline 1955, 119-121, 149-150, 152; Aline and Eero Saarinen Papers, 1906-1977, Resume / Biographical information. Archives of American Art, Smithsonian Institution.*

[395] *Saarinen had a strong conviction in educating the client. "Eero would never just show one solution to a problem… he would also show them [clients] the approaches that led up to it. So that they would see that he had thought of all these other alternatives before he finally concluded what he thought it should be," remembers Glen Paulsen. Glen Paulsen with John Gerard, May 18, 1982, 13. Collection of Oral History Interviews, No. 273. Cranbrook Archives; see also Akrich 1992.*

strength was not merely the act of transporting, but the acts of transforming, displacing and translating the material.

Latour calls Pasteur's laboratory procedures the primary mechanism of recruitment and emphasizes that it needs to be matched with a secondary mechanism, which guarantees the attribution of credit to the mobilizing actor. Thus the recruitment of collaborators and supporters simultaneously advancing their own cause and that of Pasteur was equally important to the bacteriologists. Pasteur's laboratory had to become an obligatory point of passage without which it was impossible to advance in a certain direction. Yet, recruited actors are never simply intermediaries faithfully transporting information but mediators who, when mobilized and thus displaced, similarly displace and translate the cause to match their own. Therefore Pasteurians had to displace, or translate the intentions of other groups such as the hygienists by adopting their project and adding to it an element that would strengthen both projects. They were able to establish this by introducing the action of the microbes in social links hence destabilizing systems that had been formed without awareness of the microbes. In the process the hygienist movement and physicians were skillfully recruited and attribution redirected to Pasteur's work in the various fields of biochemistry, bacteriology, and immunology until it was impossible to distinguish between Pasteur the man and "Pasteur" or pasteurism, a phenomenon to which everything was attributed.[396]

Similarly, Saarinen's office not only worked in a manner of a scientific laboratory, but its work was carried out in a network of interested and influential actors and non-human *actants*. Thus Saarinen's practice may be described with the aid of a modified version of the Actor Network Theory. Obviously the Saarinen studio itself formed a network of designers and architects and other personnel. This internal network was matched by an external one connecting the laboratory to collaborators, participants in the design process, and end-users: clients, engineers, specialists of various fields, manufacturers, construction workers, architects, relevant government and municipal officials and regulators, users of the building, travelers, airport personnel and so forth. The network was further extended to non-human *actants* that similarly functioned as collaborators, participants and end-users of the design process: the aircraft, materials (some of them highly experimental), IATA, regulations governing the construction of airports, design practices yielding certain designs more probable than others, and economic concerns influencing the design. Even the specifics involved in servicing and making the aircraft functional such as materials, fuels, airplane parts and aerodynamics were *actants* in the network constructing the airport terminal.

Hence political, aesthetic, technological, organizational and economic interests merged on all levels of the design process until it was impossible to distinguish between them. What was clear though was the fact that Eero Saarinen was the architect responsible for the spatial reorganization and innovative design of the airport and that his airports entered the canon of modern architecture. Although there were several beneficiaries in the design process, Eero Saarinen was the actor who had mobilized the process and to whom the praise for the new design was directed. The design process then strengthened his position

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[396] *Latour 1988 (1984), 34-36, 42-44, 75-92.*

in the field of architecture until Eero Saarinen became “Saarinen,” an architectural phenomenon represented in the canon of modern architecture.

Saarinen was not the only architect, whose office and working methods could be described as a laboratory. Therefore extending this interpretative framework to other architectural practices would be beneficial. Viewing postwar architectural offices as laboratories laboring in the networks of modernity reveals architecture as knowledge production, where each building stands out as a statement and mediates, in the case of postwar architecture, modernity to those subjected to the processes of modernization. Furthermore, interpreting the architectural network along these lines questions the traditional concept of an innovator. Conventionally, invention in architecture, art, technology or science has been a sudden insight in the mind of a talented individual, sometimes a genius. This legitimates the notion of private property of invention and facilitates the crediting of individual talent. In the postwar era the emergence of large corporate research laboratories questioned this traditional view of invention in science and replaced the idea of a sole innovator with a notion of depersonalized invention and applied science. It was now believed that if corporations or individuals were given equal access to scientific knowledge, resources, and trained staff, results would follow inevitably.[397]

This development was closely tied to the emergence of the wartime military-industrial-academic complex, and initiated in the Manhattan Project, a secret government program combining universities, industry and the armed forces to develop the atomic bomb in thirty-seven installations employing 200,000 workers. During the war many science laboratories collaborated with industrial giants such as DuPont (Metallurgical Laboratory in Chigaco), Raytheon (MIT Radiation Laboratory) and Tennessee-Eastman Co. (Oak Ridge Laboratory), and adopted industrial-style management and centralized modes of production into laboratory work. Physicists, chemists, metallurgists and electrical engineers working in the wartime military-industrial-academic production sites learned that such centralized, hierarchical, collaborative, and mission-directed production was essential to large-scale science. This experience influenced the architecture of science and the inhabitants of that space. After the war, continuous working shifts and the organization of workforce into teams comprising engineers, scientists and technicians was likewise adapted into corporate laboratories modeled after the military-industrial-academic complex.[398] However, military expenditure’s increasing influence on research policies and corporate management through allocations and contracts was also criticized, and President Dwight Eisenhower addressed these concerns when he in his farewell address to the nation in January 1961 referred to such installations as the military-industrial complex. More recently, Bruno Latour has defined military-industrial complexes as techno-science, which is not limited to weapon systems, but includes also aircraft, transport, electronic, energy, space, communication, and healthcare technologies. Architects’ role in techno-science is to facilitate its formation by giving architectural form to the military-industrial-academic complex.[399]

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[397] *Latour 1988 (1984), 14-15; MacKenzie 1990, 27.*

[398] *Galison & Jones 1999, 504.*

[399] *Davidson 1995, 185-225; Hughes 2004, 77-83; Latour 1987, 170-172.*

The military-industrial-academic complex offered new models for the organization of scientific space and management of complex processes. Before the armistice hybrid architect-engineer-building companies such as the Austin Company had constructed massive production sites characterized by flexible working space, vast open areas, high-capacity limits for floor loading, better climate control, brighter and more even lighting, higher bays and more powerful mechanical means for moving heavy equipment. After the war such companies applied their skills in wartime factory building to construct large-scale laboratories. They utilized advanced building techniques to create elementary modules serviced with air, heat, illumination, ventilation, gas and electricity. These modular structures allowed flexible extension of laboratories and service lines and constructed a functional working environment for modern science. One of the most revolutionary factors of the modern science space was total climate control, which was achieved following the demands of wartime factories and postwar government laboratories like Los Alamos, Oak Ridge and Hanford to create a twenty-four-hour production environment.[400]

Corporations working with new technologies were the first to adapt the systems approach developed in the weapons industry to the management of large-scale organizations, but it influenced also other sites of production.[401] Peter Galison and Caroline A. Jones have in their collaborative study found interesting similarities between the postwar laboratory and the artist's studio. They argue that both were remodeled after the wartime factory into centralized and enlarged working sites employing modes of industrial production and mimicking the hierarchical military command structure. The studio thus resembled the architecture of modern science, the laboratory.[402] Likewise, the changes in industrial and corporate culture influenced the management and organization of the architectural studio, which was developing into offices working in many geographical locations and employing tens or even hundreds of architects. Thus the architectural office was similarly transformed into a large laboratory of trained architects, who worked in teams not unlike those of the corporate laboratories.[403]

Saarinen was involved in giving form to the corporate campuses and laboratories modeled after the military-industrial-academic complex. The International Business Machines (IBM) manufacturing facility in Rochester, Minnesota (1956-58), IBM's Thomas J. Watson Research Center in Yorktown, New York (1956-61), and Bell Telephone Laboratories in Holmdel, New Jersey (1957-62), were designed by Saarinen for the new networks of science and technology. These corporations were developing the revolutionary technology of computers, satellites and radar. They worked with the rapidly

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[400] *Galison & Jones 1999, 499-503.*

[401] *Hughes 2004, 82-83.*

[402] *The authors argue that this phase of development did not last long, since already in the seventies centralized production and the site of experiments was disintegrating into dispersed sites with multiple authors. Galison & Jones 1999, 497-498.*

[403] *The team work quality of the postwar design process was accurately expressed by Saarinen's contemporary practitioner Viljo Revell discussing his design for the Toronto City Hall in an interview with Canadian Broadcasting Corporation in 1958: "It was team work you see." Santala 2010, 45-46.*

developing fields of cybernetics, aerospace technology and advanced modes of communication. Several Nobel Prize winners worked in the mirrored glass building Saarinen designed for the Bell Labs and the products included not only telephones, but also communication satellites, hardware for radar and data communication, electronic switching systems, pathways for telephone connections, microwave transmissions, international television transmission via Telstar and radio astronomy.[404] These companies, their products and the buildings Saarinen built for them functioned as signs of modernity, postwar prosperity, innovation, and orientation toward the future and the limitless technological possibilities it seemed to offer.

While Saarinen designed these corporate campuses and laboratories, he was reorganizing his own office to better meet the demands of his growing business. In fact, the office changed from a small informal atelier of only ten architects in 1949 to a large office employing forty architects in 1956 and eighty architects in 1960.[405] At the peak of its practice the office had 125 employees.[406] It was not a coincidence that an architectural office, which approached its projects with a scientific mindset and rigorous research, organized itself to mirror the corporate laboratories that were its major clients. Saarinen's office not only grouped its personnel into teams but also worked along a laboratory-like methodology and discipline; projects were approached through research and long processes of hypothesizing, testing, proving, redeveloping, improving, retesting, and proving that finally produced the desired effect, a building committed to the client, the program and the future that particular corporation imagined. The office worked ten hours per day seven days per week and it was not uncommon for architects to work extra hours,

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[404] *Merkel 2005, 89-91; Santala 2006b, 11.*

[405] *Lessing 1960, 96; Glenn Paulsen's recollection of the office in 1949 is documented in* Saarinen Swanson Reunion Proceedings *2001, 31. In this study I am concentrating on the recollections of the architects who worked on the airport projects and whose recollections of projects have been documented in the Cranbrook archives. These architects include Raymond Bean, Gary Brown, Manuel Dumlao, David Hoedmaker, Harold Roth, James Smith (models), Robert Ziegelman, and Lewis Zurlo on Dulles; Raymond Bean, Claude DeForest, Allan Dehar, and Cesar Pelli on TWA Terminal Building at New York International Airport. In addition Kevin Roche was working on all projects as Head of Design and Balthazar Korab took pictures of models for the airports and the actual buildings. Many of these recollections were documented in the Saarinen Swanson Reunion organized at Cranbrook in 1995 and published in a book edited by Cathy Price. Longer unedited transcript of the proceedings is in Saarinen/Swanson Reunion Records, 2001-14, box 3. Cranbrook Archives. When this transcript, or the letters concerning the editing of the transcript, do not offer any additional or unpublished information, I refer to* Saarinen Swanson Reunion Proceedings *as the edited version produced in collaboration with the participants.*

[406] *Joseph N. Lacy with John Gerard, September 15, 1981, 9. Collection of Oral History Interviews, No. 240. Cranbrook Archives. However, in a letter to Aline B. Saarinen, Eero Saarinen expressed his frustration about the fact, that as the principal architect he had to work as part of a team and in this role had less time to draw since he spent most of his time in meetings, travel and telephone conversations. In 1953 the office had 26 employees but in Saarinen's opinion the ideal number would be 20. Correspondence: Eero Saarinen to Aline Saarinen, 1953, Box 2, Folder 26, 8. Aline and Eero Saarinen papers 1906-1977. Archives of American Art, Smithsonian Institution.*

cancel holidays or be called back to the office once Saarinen returned after a late dinner.[407] In return, architects in the studio were given a lot of responsibility to develop original ideas and explore alternatives. Saarinen's studio was then in many ways a design laboratory where alternative structures and forms were developed and competed against each other. The internal structure of the office and the external social network were engineered to generate support for the practice and sustain resources for the experimental design.

Saarinen worked in the manner of what John Law has called a "heterogeneous engineer."[408] He labored to build a larger network (which Law calls global) and created negotiation space within which his local network could function. Describing the design process along the lines of these interconnected networks questions the commonly assumed distinction between a determined actor and the determining structure. Instead the process becomes that of mutual shaping, negotiation and exchange of intermediaries between the expanding networks. For instance, in the case of the Dulles Airport, credible descriptions about the airport's design, construction details, budget and probable delivery date had to be produced as intermediaries in order to satisfy the global network of multiple clients,[409] obtain funds and guarantee support for the project. Intermediaries including finance, political support and technical specifications could then flow from the global network to mobilize a more permanent local network consisting of designers, designs, production teams, management and subcontractors. Heterogeneous actors including geopolitical factors like land distribution, technological changes in the jet aircraft requirements, natural occurring features such as prevailing winds, and human geographical considerations like the availability of airstrips, shaped the development of the project. Ultimately it was this network of heterogeneous actors that determined the process, which was by no means linear but rather evolved through answering questions posed in the previous stage of design. The architectural office functioned as an obligatory point of passage and managed the negotiations between the various networks and heterogeneous actors involved.

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[407] *Glen Paulsen remembers how "it was typical to work at least two or four nights a week. I can remember working Saturdays and Sundays and literally it was an eighty-hour week. Eero worked every night, if you were working closely with him, which I was, he would just expect you to be there." Glen Paulsen with John Gerard, May 18, 1982, 7. Collection of Oral History Interviews, No. 273. Cranbrook Archives; Joseph N. Lacy with John Gerard, September 15, 1981, 10. Collection of Oral History Interviews, No. 273. Cranbrook Archives.*

[408] *Law 1987, see also chapter 2.2 in this study.*

[409] *In fact, airport commission is a complicated project for the architect and the consulting structural, mechanical, and electrical engineers involved. It includes a multiplicity of clients that often consist of an official body (the federal government in the case of Dulles), local governments, the airlines, federal agencies and departments, managers of concessionaires etc.* Progressive Architecture *reported already in 1953 that based on interviews with architects and engineers, who had experience in airport design, the multiplicity of clients complicated the design process and postponed the completion of the project. The fee paid to the architect was then not proportionate to the task involved. Twentieth Century Building Type 1953, 116.*

Without its incremental role and success in managing the process, the airport would not have been finalized.[410]

Saarinen was well known for his good business sense and negotiations skills, but equally noted for poor management of project funding. The design process was not economical because hundreds of hours and resources were wasted experimenting with alternative designs. "Eero would never think about the time that had been invested in an idea," recalls Glen Paulsen (b. 1917), who worked in the office in 1949-51 and 1953-57: "If he found a better idea and was halfway down the road to completion he wouldn't hesitate for one second to drop everything and start over again… the office I'm sure did not realize a profit on a lot of that earlier work."[411]

It is then perhaps not surprising that the restructuring of the Saarinen office was initiated with the hiring of John Dinkeloo (1918-1981) in 1950. Dinkeloo was an experienced project manager at Skidmore, Owings & Merrill (the large architectural firm behind the design of the Manhattan Project). His role in the Saarinen office was seminal not only because of his managerial and organizational skills but also because of his thorough expertise in new technologies and his innovative thinking in engineering. He was largely responsible for the use of experimental new materials and technological innovations that became Saarinen's signature. With Dinkeloo's lead the Saarinen office was gradually restructured into three departments. Joseph N. Lacy (1906-1997) was the Head of Finance, another new hire Kevin Roche (b. 1922) became the Head of Design in 1954, and John Dinkeloo the Head of Technical Development, Project Management and Production Documents. Aline B. Saarinen was responsible for the public relations strategy under the title Information Director. Her network and professionalism ensured that media was skillfully utilized to gain publicity. The firm, for instance, employed Charles Eames as a filmmaker and hired notable photographers such as Ezra Stoller to take publicity pictures. This was not unusual postwar practice but Saarinen's office was particularly skillful in utilizing media and publicizing its projects.

The office was restructured into teams working on various projects simultaneously, and each project had a project manager, who attended client meetings with Saarinen and Roche. The design of Saarinen's airports exemplifies this process well. "The Dulles Airport was a very large project in terms of the size of the team," recalls Norman Perttula, who worked in the office 1956-61 and acted as the design team captain on the project, but the designers, "worked out details in close conjunction with the people doing the

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[410] In a similar analysis on the Tactical Strike and Reconnaissance aircraft TSR.2 Law and Michel Callon have described the way managers positioned the project in a global network of policy makers in order to obtain time and resources needed to build and maintain a local network for the aircraft's production. Their analysis shows that this particular project failed because the local network did not manage to create a single location as an obligatory point of passage. The global network's effect on the local one was neither controlled nor negotiated properly and thus necessary intermediaries were not guaranteed nor delivered. Ultimately the political and structural changes in the expanding global network led to the cancellation of the entire project. Law & Callon 1992, 21-47.

[411] Glen Paulsen with John Gerard, May 18, 1982 12. Collection of Oral History Interviews, No. 273. Cranbrook Archives.

production of the contract documents… Often it would be the design team captain who met with the project team captain, and it was the design team captain who was the liaison with the engineers who were consultants on the project. The information flow started from Eero to Kevin, from Kevin to the design team, and then carried on that way through to the consultants on the job." Hence, Saarinen guaranteed consistent support for his projects from the global network and assured that the local one was committed to deliver in time because "there was a complete unity of all design information through all the team members."[412] These teams worked quite independently along the guidelines provided by Saarinen. "A team comprised of about twelve architects designed TWA," describes Cesar Pelli (b. 1926), who worked in the office 1954-1964, and, "together with Kevin [Roche] we prepared for presentations to Eero which were halfway presentations or work session to study the model. They were very critical to how the teams worked"[413] and thus managed the project with close control of details but allowed an unrestricted flow of ideas and design alternatives. Saarinen was then managing the project as a "heterogeneous engineer" and his office acted as the obligatory point of passage ensuring the smooth flow of information, intermediaries and ultimately, the completion of the project.

The Saarinen office approached architectural problems with rigorous research. "Every problem was unique and you would begin literally from the very beginning," recalls Paulsen, "We would get a full batch of plans of the particular building type, many different solutions to the problem. We would get them drawn up photostatically to the same scale and then we'd tack them up on a tackboard and then study them. Their organizational qualities, study the scale characteristics and then take different groups of buildings and study organizational relationships between buildings and outdoor space… The issues would be thought out from the broadest aspects of the problem down to the minutest aspect. And once this had been researched out, and a set of design criteria or objectives had been established, then we would start conceptualizing."[414] Out of this research then emerged new organizational principles for airports, laboratories and corporate campuses.

Saarinen's scientific design method was parallel to the interest his clients had in designing functional, efficient, and appealing office campuses that enforced the corporate image. They wanted flexibility, adaptable and quiet laboratories, centrally located common facilities, low construction and operating costs, and easily expandable structures.[415] Corporate campuses had to create agreeable working environments, and Saarinen was very skillful in using architectural vocabularies to express and enforce the corporate image. Often this took the form of innovative structural solutions and construction techniques that he was the first to use. Thus the International Business Machines facility in Rochester had the world's thinnest curtain wall of 5/16 of an inch, Bell Laboratories sported the first mirrored glass façade and John Deere headquarters was

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[412] *Norman Perttula recollection.* Saarinen Swanson Reunion Proceedings *2001, 33.*

[413] *Cesar Pelli recollection.* Saarinen Swanson Reunion Proceedings *2001, 36.*

[414] *Glen Paulsen with John Gerard, May 18, 1982, 10-11. Collection of Oral History Interviews, No. 273. Cranbrook Archives.*

[415] *Merkel 2005, 89.*

constructed with self-rusting Cor-Ten steel. These “firsts” were brilliantly used as advertisement for the corporation and the architectural office of Saarinen. “We did it to attract good, intelligent engineers and executives,” confirms William A. Hewitt, the CEO of Deere and Company, “and to send a message to customers that this company must make a good product if they work in such a fine building. And it turned out to be a big bargain!”[416] Yet, as Alexandra Lange has observed, the company-specific symbolism in the corporate campuses was “incorporated into the façades, while the plans were variations on the same organizing principles.”[417] They were all examples of what Reinhold Martin has called the organizational complex, the principles organizing postwar corporate space and the inhabitants of that space.[418]

The International Business Machines manufacturing facility in Rochester was Saarinen’s first plan to reorganize effectively the corporate campus of laboratories, offices and manufacturing plants. Based on the ratio IBM used for the relative amount of space needed for different functions, Saarinen developed a sixty-thousand-square-foot, one-story module for the factory space and a forty-thousand-square-foot, two-story module for offices and laboratories.[419] These pavilions were organized in a checkerboard pattern with intervening garden courts and connecting corridors. The thin curtain walls were constructed with aluminum panels laminated on an asbestos cement core and porcelainized on the exterior in two tones of blues (fig. 5.1).[420] As Reinhold Martin has argued the plan thus resembled the machines the company was known for and read as a clear organizational space for a new culture of cybernetics. The campus functioned as logically as the first IBM computers that at the time still filled entire rooms with sophisticated machines glad in plain, thin-shelled boxes not unlike the modular architectural ensemble housing them.[421]

IBM’s Thomas J. Watson Research Center and Bell Telephone Laboratories offered a new organizational model for a modern research laboratory. Both had short interior corridors leading to long exterior corridors that run along the outer wall. These provided views of the surroundings and integrated architecture with the landscape. Importantly, circulation and information flows were directed away from the private science laboratories placed along the shorter corridors. Saarinen’s scheme replaced the previous model for laboratory buildings best exemplified by the narrow finger plan of Ralph Walker’s Bell Labs Murray Hill complex. This type of a finger plan had become obsolete when air-

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[416] *William and Patricia Hewitt interview with Wesley Janz, April 23, 1992, 10. Cranbrook Archives. Original in the Wesley R. Janz collection of transcripts of oral history interviews, 1992, 9809 Aa2. Bentley Historical Library, University of Michigan Library.*

[417] *Lange 2006, 277.*

[418] *Martin 2003.*

[419] *IBM inaugurated a new design strategy in 1956. Under the leadership of industrial designer Eliot Noyes it involved hiring graphic designer Paul Rand to create a new logo and Ray and Charles Eames to make films and exhibitions. Marcel Breuer and Noyes himself designed several of the company’s buildings. Harwood 2011; Merkel 2005, 86-87.*

[420] *Recent Work of Eero Saarinen with some Statements by Eero Saarinen 1959, 57.*

[421] *Martin 2000, 140-163, especially 156.*

conditioning and fluorescent lighting yielded scientists' demands for better-controlled environment, increased privacy and greater intercommunication feasible. Furthermore, the changing needs of research and related technologies necessitated flexibility of space and laboratory arrangements. Hence, Saarinen adapted the advances made in wartime factory building into his designs, which concentrated utilities into a service core, utilized modular service structures, and featured progressive lighting and environmental controls.[422]

The design of IBM's Research Center was based on extensive research on the working habits of the scientists, who would use the building, and the planning process was then very similar to the design and planning strategies adopted for the airport planning problem. Saarinen conducted interviews, observed scientists at work, and sincerely tried to achieve a well functioning and aesthetically pleasing working environment. He learned that existing research laboratories had noisy corridors and poor communication channels, and that individual laboratories often had to cover their windows to prevent light and heat from interfering with experiments. Based on these findings Saarinen created a 1, 090 feet long curving building with façades of glass shedding light into long corridors running along them (fig. 5.2). Shorter corridors housing laboratories and offices set on a 4 by 6 feet modular grid interconnected the long corridors. Laboratories were placed back to back with a 4-feet wide service and utilities spine between them, while offices were located against architect-designed storage walls. Thus, the compact pattern offered privacy, short communication lines and great flexibility. The visually appealing environment was completed with a Japanese garden created by Sasaki, Walker & Associates.[423]

The Bell Telephone Laboratories building in Holmdel was referred to as "the biggest mirror ever,"[424] because of the revolutionary mirrored glass façade that reflected the surrounding landscape during daylight and revealed the interior lights at night (fig. 5.3). As Anthony Vidler put it, the building took "its place between radar installations and a Nike X missile base as a third elegant and expensive piece of equipment to be deployed in the fields of Holmdel."[425] The symmetrical building was set within an elliptical parkway serving parking lots at each end of the building, and its central entrance was marked with a horizontal plane. The interior had a top lighted cruciform central space, which separated four laboratory blocks. Services for the laboratories were located on a lower floor accommodating plant rooms for laboratories, a computer center, an auditorium, a cafeteria, lounges and other communal spaces. A continuous circulation was thus created

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[422] *Saarinen's Design Puts Flexibility, Comfort, Beauty in New Bell Labs' Development Center. News from Bell Telephone Laboratories, Sept. 27, 1962. Press material, box 421, folder 1198; Drawings, boxes 413-414. Series IV. Project Records. Job 5703: Bell Telephone Laboratories, Holmdel, NJ. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Lessing 1960, 101; Research Center, Yorktown, N.Y. 1962, 924.*

[423] *Research Center, Yorktown, N.Y. 1962; IBM's New Research Center 1961, 80-85; Unique Cross-curve Plan for IBM Research Center 1961, 137-147. Drawings, box 366. Series IV. Project Records, Job 5606: International Business Machines [IBM], Yorktown. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[424] *The Biggest Mirror Ever 1967, 33-41.*

[425] *Vidler 1967, 355-359.*

between the laboratories and the mirrored glass. The partitioning system used a 6-feet module, which created units with 5000 square feet of clear floor space to be divided into laboratories and offices.

The mirrored glass façade at Bell Labs reflected 75 per cent of the sun's heat at 25 per cent light transmission. This innovative material was based on space research that had developed techniques to vacuum deposit ultrathin metal films on space vehicles in order to ward off radiation. Saarinen adapted this technique into architecture and experimented with reflexive metal films on glass in collaboration with Kinney Vacuum Division of the New York Air Brake Co., a company involved in space research, and Laminated Glass Corp., which was making replacement safety glass for the automobile industry. The result was a laminate with a thin film of silvery aluminum or pure gold bonded between the panes for weather protection. Thus, Bell Labs not only reorganized the laboratory space but its façades reflected the high technology research conducted within its mirrored walls.[426] Yet, the mirrored glass façades were factually only reflecting the surrounding landscape and even at night they revealed nothing but the skeleton structure of hollow corridors. Hence, the organizational complex exemplified by the Bell Labs remained mute on surface; it reflected every signal back to the outside world while keeping its interior feedback loops intact.[427]

Eero Saarinen's corporate campuses designed for Bell and other leading high technology companies were part of the new economics of power and the architectural organization of production, labor and corporate culture. They materialized that culture and had very real effects on the inhabitants of that space. In a similar manner to how his buildings represented the technologies they housed, the social organization of the Saarinen office resembled the social organization of its high technology clients. His office was an architectural laboratory that reorganized postwar corporate laboratory space and high technology production sites while transforming the architectural office itself into a laboratory experimenting with innovative materials, new technologies and the revised vocabularies of modern architecture. Saarinen was then a "heterogeneous engineer," whose office was giving form to techno-science.

5.1. Negotiating Technology and Aesthetics

Eero Saarinen's office was known for its research-based approach to design problems. In fact, Jayne Merkel, author of a Saarinen biography, claims that emphasis on research and development was one of his main contributions to architecture, and it was definitely

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[426] *Lessing 1960, 102; Construction Highlights of Bell Laboratories' New Development Center in Holmdel, N.J. News from Bell Telephone Laboratories, Sept. 26, 1962; Saarinen's Design Puts Flexibility, Comfort, Beauty in New Bell Labs' Development Center. News from Bell Telephone Laboratories, Sept. 27, 1962. Press material, box 421, folder 1198; Drawings, boxes 413-414. Series IV. Project Records. Job 5703: Bell Telephone Laboratories, Holmdel, NJ. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[427] *Martin 2003, 211; Vidler 1967, 358.*

appreciated by his clients, who were the most prominent technical innovators of his period.[428] Saarinen investigated new technologies and materials and pushed them to their limits often by asking manufacturers to consider new uses for their products. Great examples of this approach are the use of neoprene gaskets in curtain walls and the utilization of mirrored glass in façades. The firm felt it was responsible for the new technologies adapted for its buildings and therefore tested each new idea, form or material in models, mock-ups, or controlled experiments.[429]

Another innovative aspect of the office was the utilization of large-scale study models as a primary design tool (fig. 5.4). Most firms produce models of complete designs, but the Saarinen office utilized study models to arrive at a final scheme. "One type described 'official reality,'" recalls Cesar Pelli. It "was very beautifully made and photographed to look like the real thing. The other type of model was to me the greatest invention and they were the very crude, large-scale models; some full size or nearly so. The TWA model was probably the one that truly started the very large-scale models. It happened without any prompting. We started by building a column. Then Eero wanted to see how the wall met the column and related to it, and then how the space and the wall were going to work. Before we knew it, we had a huge piece of the wall constructed. It was not built in its entirety, because the room barely accommodated half of the model."[430] Instead, the other half of the symmetrical building was imagined with a mirror. Large-scale models provided an efficient working method to "understand the problem and make a decision instantly. The speediest process prior to this was where Eero would sit down with us and make drawing after drawing… With the large-scale models he could reach the same conclusions in five minutes, then give directions for another model and come back a few days later."[431] Hence, study models visualized design alternatives immediately and allowed different teams to work on the project simultaneously. Drawings were often based on solutions reached on modeling and especially the TWA Terminal was known for hundreds of drawings, which the contractor had to produce to be able to understand mathematically the complicated forms of the thin shell structure.[432]

Saarinen's working method was revolutionary especially because it allowed him to design forms that have only recently become common with the aid of computer-based design tools such as CAD (computer-aided-drafting) and CAM (computer-aided-modeling). Hence, work on study models makes Saarinen an interesting precursor of contemporary practitioners.[433] Surprisingly, only a few attempts have been made to analyze this kind of architectural model work as an effective design tool. Within the

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[428] *Merkel 2005, 148.*

[429] *Lessing 1960, 103.*

[430] *Cesar Pelli recollection.* Saarinen Swanson Reunion Proceedings *2001, 36-37.*

[431] *Cesar Pelli recollection.* Saarinen Swanson Reunion Proceedings *2001, 36-37.*

[432] *Shaping a Two-acre Sculpture 1960, 119.*

[433] *Antoine Picon places Saarinen's practice in the context of the history and emergence of digital architecture. Saarinen was interested in patterns and his buildings (including the TWA Terminal and Dulles Airport) are examples of concrete shells and tensile structures postwar practitioners experimented with. These were precursors of forms achieved later with computer-aided planning. Picon 2010b, 34, 45, 70.*

multidisciplinary field of Science and Technology Studies the work on models is described as a network or a process of negotiations where competing and contradicting views are reconciled. In his study on the Tactical Strike and Reconnaissance aircraft, the TSR.2 (designed in the late 1950s and early 1960s), John Law describes models made for the development of airplane wings as objects, over which conflicts and negotiations form a sequential process of prototyping and testing, in order to establish the best possible wing design in terms of a relatively stable and determinate shape. According to Law, this process does not only negotiate the technical constraints of the design, but aims to incorporate conflicting political and economic interests into an acceptable and yet innovative design.[434] Architectural design, where models are used as a design tool the way they were used in the Saarinen office, could likewise be described as a process in which the best possible form and organizational layout are determined through formwork, testing and improving, and during which the potentially contradictory aims of the interest groups involved are negotiated into a functional and yet innovative and expressive architectural form.

Based on a field study in Rem Koolhaas' office Albena Yaneva has analyzed how architects work, imagine and define the architectural object through design processes. She claims that scaling trials, the transitions between small-scale and large-scale models – scaling up, jumping the scale and scaling down –make the building gradually visible, material and real. Hence, scaling trials define the building. Throughout the process two alternative states of the building –a large-scale and comprehensive model and a concrete and detailed model –are simultaneously worked on in the Koolhaas office.[435] While Yaneva's descriptions of architectural scale modeling are not entirely convincing, I agree with her identification of the architectural office as a laboratory and with her treatment of scale modeling as a scientific tool. Her studies follow the tradition of the anthropology of science,[436] which from a historian's perspective seems insufficient to address the question. Yaneva's descriptions do not take into account the definition, history and tradition of architecture, which are likewise negotiated through the design process. Nor does she discuss the multifaceted structure of architectural production even though the network involved in design work is much wider than the immediate actors present in the office space. Her descriptions are thus incomplete. Nevertheless, they open a possibility for further research and treatment of the architectural office as a laboratory, which not only institutionalizes architecture but also is simultaneously reconstituted in a continuous process that aims to stabilize a heterogeneous group of actors. This offers a new viewpoint into the role of actors in the architectural office and empowers them to redefine not only

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[434] *Law 2002, 91-114.*

[435] *Yaneva 2005, 867-894. In a similar study on the art world and the museum, Yaneva claims that the museum does not simply visualize culture or organize it into a coherent whole in a form of a collection but is actively produced in the network of art production. She defines the museum as a quasi-technical network involved in art fabrication work. The museum may then be viewed as a laboratory, where experimentations and negotiations profuse and stabilize a heterogeneous group of actors. This process may likewise be followed through its controversies, negotiations, adjustments and stabilization. Yaneva 2003, 116-131.*

[436] *A classic study in the anthropology of science is Latour & Woolgar 1986.*

architecture, but also culture and society. Hence, they could in theory be followed like scientists from the laboratory to the construction site.

In contrast, Law in his study on the TSR.2 aircraft seems frustrated with the parameters of the Actor Network Theory. He seeks to fragment what initially was intended as a socio-technological study of an aircraft into small stories narrated in sequences that may coincide to form a "fractionally coherent" whole. His earlier descriptions of the same material exhaustively outline the TSR.2 aircraft project as a creation of a local and global network. Yet, his later work on the same topic cancels out what he calls the "arborescence," the treelike singular and coherent modernist storyline of a grand project. According to Law, this standard narrative trope of late modernity organizes technologies into linear, chronologically ordered projects and systems. Instead Law aims to move beyond both, the modernist concept of knowledge where subject and object are centered coherent entities, and the postmodernist notion that everything is fragmented and without a center. He argues for "fractional coherence," where things are drawn together without necessarily being centered and explores storytelling as a rhizomatic network, as a poststructuralist alternative. In his view, knowing subjects and objects are multiple; they are assemblages that make singularities out of multiplicity. His narrative then follows the logic of a pinboard where narratives are juxtaposed in a manner that does not conceal multiplicity, but rather performs political and fractional ways of knowing.[437] Hence, together his earlier and later work illustrates the possibilities and the limits of the Actor Network Theory approach in the study of design.

However, even if from a scholarly point of view Law's rhizomatic structure takes the network approach past its limits and creates a single multifaceted story, from the reader's point of view the rhizomatic storyline leaves the reader unsatisfied and the story largely untold. Hence, it seems to me that the fragments do not hold up for *history* unless the gaps are narrated and a coherent, intriguing story performed first. A single story must be told before its multifaceted nature is revealed, and attempts to fragment the storyline and create "fractional coherence" appreciated.

The design process performed in the Saarinen office in the late fifties cannot be verified with a field study, but neither does it make sense to try to tell the story of his office with a fragmented rhizomatic structure. Instead, it seems intriguing to describe the design process as completely as is possible based on the historic documents available. This "thick description" is in itself only "fractionally coherent" as the historic fragments do not quite form a linear and complete storyline. Instead, much must be narrated, imagined, interpreted and understood without necessarily verifiable links. If one is aware of the difficulties involved in writing history, the storyline *is* "multiplicity that performs singularity." In other words, a history may be written that appreciates all the *actants*, politics, conflicts and negotiations that went into making a singular story. Yet, it seems to me that history cannot be written without a narrator, who holds the story together. History is necessarily centered; it is arranged around the anchor of the narrator. Perhaps, it is then historiography rather than history that creates the "fractional coherence." Historiography is constructed out of juxtaposed narratives and could be described as a rhizomatic

[437] *Law 2002, 2-8, 183-185.*

network. In contrast there is always the voice of the positioned, historically situated narrator present in any *his*tory told. It simply cannot be erased from the storyline, but must be acknowledged. As a reader and as a writer one needs to be aware of the presence of the narrator.[438]

While describing the design process in the Saarinen office as completely as possible, it is then equally intriguing to fragment the singular and coherent storyline of modern architecture by telling the story of the airport terminals Saarinen designed as nodes in the networks of science and technology. These airports were an integral part of the techno-environment, which was forming in the start of the sixties. As such they reveal silences in the history of modern architecture through which it is possible to replace some of its most commonly accepted assumptions. These are the assumed parallelism between the development of architecture and technology, and the notion of the architect as an innovator. If there is a parallel between architecture and technology it is not that architecture follows the natural development trajectory of technology but that architecture and technology are similar cultural constructions. Neither develops according to a presupposed trajectory but the advancement is anticipated, enforced and realized by politically, economically and socially motivated actors.[439] Similarly the architect is not an isolated innovator but an actor in a network, who in a manner of a "heterogeneous engineer" labors to negotiate technology and aesthetics.

What was then the sequence of the design process in the Saarinen office? Descriptions of the working methods in the Saarinen office seem to suggest that form giving took place only after the rigorous research process was carried through and the organizational problem of the airport solved. "Eero never started with form," confirms Kevin Roche, "He had an approach rather similar to a scientist or researcher of starting with trying to define what is the problem… In the case of the airplane thing –which we are all very familiar – the stopwatch and timing, when planes take off and when they land… The process was very slow, very, very methodical, and very careful. By the time he got to thinking of the form, he already knew more about the subject than probably the people who had asked him to do the building in the first place. More about what was needed, more about the functional aspects, and he had thoroughly investigated also all of the other relationships, the urban design, the cultural environment, all of these things, which one normally takes into account. The process was methodical, careful, exasperatingly slow at times, and thorough."[440] However, Robert Venturi (b. 1925), who worked for Saarinen between 1950 and 1953, claims instead that Saarinen's design process had less to do with programmatic efficiency than "stylistic expression." He describes Saarinen's approach to design as "arbitrary, stylistic and fashionable… costume-like approach… Modernism rejected the idea of style but… Eero's modernism was stylistic –stylistically eclectic."[441]

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[438] *I discus the principles of history writing in more detail in introduction and chapter 2 of this study.*

[439] *I discuss this in more detail in chapter 2 of this study.*

[440] *Kevin Roche as quoted in Appreciations by Former Collaborators: Panel Discussion with Cesar Pelli, Kevin Roche, Harold Roth and Robert Venturi 2006, 360.*

[441] *Robert Venturi as quoted in Appreciations by Former Collaborators: Panel Discussion with Cesar Pelli, Kevin Roche, Harold Roth and Robert Venturi 2006, 360, 364.*

Indeed, it seems that while argumentation for the strikingly innovative and structurally sound forms was supported by research, these forms were, actually, a result of experiments conducted on models. "Eero was more comfortable when he saw it in three dimensions," claims Jim Smith, who was employed between 1947 and 1960 as the specialized model maker of the office, "TWA was completely done in third dimension... that was a big three-quarter scale with many designers cutting cardboard and building the whole thing three-dimensionally. And then other people packing up and doing drawings."[442] Joseph N. Lacy describes how one group of architects was working strictly on designs and another group took the designs and converted them into working drawings. He recalls that Saarinen "wanted to see things in three dimensions. So his design approach from the very beginning of a project was a rough site model and little blocks of wood to work out a preliminary design in three dimensions. From there it went into sketch drawings and more models. As the drawings advanced more detailed models would be made. And the model shop in the office was about as important as the design department."[443] Gradually "the designers themselves were making models, cardboard models and study models. The model department spread out into the design area and wasn't just confined to a shop where models were built. At a certain point where the design was established and settled then it might go to Jimmy Smith to convert into a final model."[444]

It was this work done on models that finalized the form hinted at on the very first sketches scribbled on notepads and even napkins.[445] These, in turn, were done before any consistent research effort. The first sketches for TWA, for instance, were drawn on a restaurant menu (fig. 5.5). Aline B. Saarinen recalls how: "In 1956, shortly after the TIME Magazine cover story on Eero appeared, we had dinner in New York with Cranston Jones, who had written that story. Over coffee, the writer asked Eero what was particularly interesting him. Eero habitually talked with a pencil. He turned over the menu and began explaining his first ideas on the TWA Terminal –the concept, the plan, the site at Idlewild, the square footage. Since the building was designed in models, these rough sketches showing one of the early rudimentary vaulting solutions are unique." [446] Despite

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[442] James Smith with John Gedard, April 8, 1982, 5. Collection of Oral History Interviews, No. 242. Cranbrook Archives.

[443] Joseph N. Lacy with John Gerard, September 15, 1981, 2, 4. Collection of Oral History Interviews, No. 240 Cranbrook Archives.

[444] Joseph N. Lacy with John Gerard, September 15, 1981, 7. Collection of Oral History Interviews, No. 240 Cranbrook Archives.

[445] Sketches of Dulles were done on yellow notepad paper and some sketches of the TWA Terminal on a desk calendar (April 1957). Sketches, box 463, folder 1314. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Diaries and personal effects, box 969, folder 195. Series I. Personal Papers. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.

[446] Saarinen, Aline 1962. The same brochure includes the story about Eero Saarinen overturning a grapefruit shell at breakfast table and carving out a possible shape of the terminal building. The first sketches for the terminal building in Athens are drawn on paper torn from a yellow notepad. Eero Saarinen

maintaining his view that each project was initiated with a substantial research effort, even Roche admits how: "There were a few occasions when he [Saarinen] would arrive in the morning with a sketch; one of them was the airport in Athens… which was in its own sense, a remarkable structure."[447] In the case of the Athens International Airport, however, the readiness to design such a structure was perhaps based on the research the office had already conducted on airport architecture.

The sweeping, exuberant forms of the TWA Terminal and the structural expressionism of the Dulles Airport do not exactly support the argument that form giving followed only after the scientific research effort. Was Saarinen not an architect very much involved in the search for new modern forms better expressing the sentiment of postwar culture? Was he not the architect known for eclectic and expressionist architecture, where form seemed to rule over functional concerns and even structural integrity? When project files hold sketches outlining the final form of the building before any research effort was seemingly done, did aesthetics actually not come before technology? It is then hardly convincing that the aesthetics of these airports would have logically followed from the scientific solution to the building problem. I would rather argue that scale modeling was another scientific tool employed in the architect's laboratory to visualize the results of the research process. Thus form giving was an extension of the scientific research and data collection process conducted on the airports. And despite occasional early sketches, formwork evolved primarily through scale modeling. It could also be argued that Saarinen's scientific approach was complementing –rather than replacing –the former atelier-like design methodology of the office. Hence, there was continuation from the elder Saarinen's arts-and-crafts based practice to the younger Saarinen's rigorous research-driven approach to architecture.[448] Nevertheless, it seems imperative to ask, how Saarinen negotiated technology and aesthetics in a design process that not only involved research and experiments with materials and construction techniques, but also innovative work on models and unforeseen form giving.

Asking what is a material in relation to Saarinen's architecture Reinhold Martin claims that it is nothing more or less than what Bruno Latour calls a "nature-culture hybrid." Yet, this hybrid materiality of architecture is a complex matter in the case of an architect, who has often been thought of as a proto-postmodern or late modern architect. Martin argues that even when Saarinen made several appearances at the level of image in Charles Jencks' catalogue of late modernism, *The Language of Post-Modern Architecture,*[449] he constructed these images with innovative use of new materials and techniques. Discussing in detail the materials Saarinen used, Martin does not simply replace image with

and Associates, 1960. Athens Airport: conceptual elevation sketches. Eero Saarinen Collection DR2001:0004:001:001-DR2001:0004:001:010. Gift of David Graham Powrie. Canadian Centre for Architecture CCA Collection.

[447] *Kevin Roche as quoted in Appreciations by Former Collaborators 2006, 360.*

[448] *I thank Reinhold Martin for pointing out that there is continuity and change in the office rather than continuity or change. Hence, this is another form of synthesis Saarinen was aiming to achieve in his practice.*

[449] *Jencks 1977, 46-47, 82.*

materiality, but emphasizes the enigmatic character of Saarinen's architecture concerning the relation of materiality to image and modern to postmodern, since "Saarinen's case is also a kind of hybrid, in which such polarities as modern versus postmodern and material versus image intermingle and overlap."[450] What then made Saarinen postmodern in Martin's view was not his stylistic excess but his attentiveness to the realities of the image-based economy.[451]

Contemporary practitioners also disagree on whether Saarinen was a postmodernist or not. "Eero was using the device of function to produce form, which was really a reversion to the very earliest manifestoes of modern architecture," claims Kevin Roche, "but it produced a certain kind of sculptural exuberance, because of Eero's interest in sculpture."[452] "Saarinen's way was to make a building devoted to flight look something like a bird," argues Robert A. M. Stern, "He also tried to reinvent the classical mood through technology, as in Dulles… You could say that he was a precursor of post-modernism. He had a broad view of context as both physical and symbolic –what the culture would expect a building to look like."[453] But Philip Johnson reminds us that: "Eero was a proto-postmodernist as was I, though we had entirely different approaches. But don't forget, post-modernism doesn't exist. It broke the mold of the modern strictures, but what happened afterwards can be called by anybody's name."[454]

Perhaps an accurate description of Saarinen's architecture is that he was, in the manner of other postwar practitioners such as Johnson and Kahn, working within the modern paradigm producing simplified commercial modernism. He was intensely involved in the debates about the state of architecture and the significance of technology. "The three great principles of modern architecture," were according to him, "functional integrity, honest expression of structure, [and] awareness of our time." These were the timeless principles of architecture, but: "Tools alone do not make architecture. There must also be leadership."[455] In "Six Broad Currents of Modern Architecture" he named Frank Lloyd Wright, Le Corbusier and Mies van der Rohe as leaders, whose work crystallized its principles and constituted its major currents. Other currents were emerging. These included the North-European individualists, the American postwar individualists, and the Bauhaus that had become an American phenomenon. Architecture then had two distinct trends, which he called the individualist (exemplified by the work of Frank Lloyd Wright, Alvar Aalto, William Wurster and Pietro Belluschi) and the functionalist or the International Style (crystallized in the architecture of le Corbusier, Gropius, Mies van der Rohe and their followers). Another major influence was modern engineering and the work of Pier Nervi and Buckminster Fuller.[456]

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[450] *Martin 2006, 69-70.*

[451] *Martin 2006, 77.*

[452] *Dean 1981, 41.*

[453] *Dean 1981, 46.*

[454] *Dean 1981, 46.*

[455] *Saarinen 2006 (1959), 346-353.*

[456] *Saarinen 1953b, 110-115.*

In Saarinen's view modern architecture was not what "the founders of the modern movement had dreamed about sixty years ago," since it had become far too one sided. Modern architecture "had been codified too quickly and too materialistically. This style saw the different problems of our day all fitting into the same glass and aluminum box –an airport, a skyscraper, a girls dormitory –all looking the same." In Saarinen's opinion: "many interesting things had not been explored" and, therefore, "the vocabulary of modern architecture is being greatly expanded" in the work of the second generation.[457] In addition to the three primary principles of architecture he then added three other principles: "the expression of the building, the concern with total environment, [and] carrying a concept to its ultimate conclusion."[458] Saarinen's corporate campuses, which integrated the building with the surrounding landscape, rearranged the organizational structure of the modern laboratory and office space and architecturally expressed corporate identity, were excellent examples of these latter principles, but Saarinen also acknowledged that these principles "inevitably create a diversity of solutions, and thereby the external form of my work varies greatly." Nevertheless, he claimed: "the common denominator in my work is the constant philosophy, the constant respect, for these six principles."[459]

However, Saarinen acknowledged that occasionally one principle such as "function may become the overwhelming principle in directing the formula of design" because "the problem and the time are ripe for an entirely new functional approach to a problem, as for instance in the new Washington jet airport." He further observed how structural honesty had in the postwar years taken the form of expressing the structure and even structural expressionism. Indeed, Saarinen's own architectural oeuvre bears evidence to such a tendency and both of Saarinen's American terminal buildings could be characterized as examples of structural expressionism. "To express structure," he explained, "is not an end in itself, it is only when structure can contribute to the total and the other principles that it becomes important. The Yale Hockey Rink and the TWA Terminal are examples of this."[460]

Saarinen acknowledged that the reasons for arriving in such forms that were visually rather than structurally logical were "aesthetic and not economic." In his view: "technology; the possibilities of plastic form; the exploration of color, texture and ornament; the relation of buildings to their environment –can be thought of together as concerns and interests enlarging our vocabulary" because modern architecture was finally "mature enough to think about bigger problems of expression."[461] This problem of

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[457] Saarinen 2006 (1959), 346.

[458] Saarinen 2006 (1959), 353. See also Saarinen 1961.

[459] Saarinen 2006 (1959), 353.

[460] Saarinen 2006 (1959), 349-350.

[461] Saarinen was thus expressing the modernists' newfound interest in texture, ornament and pattern. However, Antoine Picon has argued that ornament never disappeared entirely from modern architecture but took different forms such as the articulation of construction details and materials (found for instance in Mies van der Rohe's work) and, especially after the Second World War, a newfound interest in proportions, rhythm, modulation and pattern. Picon 2013, 97- 98; Saarinen 1957, 43, 48-49.

expression was especially "crucial in the so-called 'special building.' A church must have the expression of a church. An airport should be an expression related to flight. It should make one feel the excitement of arrival and departure and the pleasures and adventures of travel." Therefore, at the TWA Terminal Saarinen "had to consider the total expression of what an airport should be like, what kind of spirit it should have, whether its structure should express its spirit."[462] Along these lines Dulles as "the new jet airport for our nation's capital also should convey its purpose by its architectural expression. The excitement of travel and the stateliness of belonging to the federal capital should be conveyed."[463] Ultimately, the concept of the building had to be "exaggerated and overstated and repeated in every part of its interior, so that wherever you are, inside or outside, the building sings with the same message. That is why… the interior of the TWA Terminal had to be the way it is."[464]

Eero Saarinen was not the only practicing architect aiming to define postwar modern architecture. In 1955 Philip Johnson described postwar modernism as functional-eclectic architecture based on "seven crutches of architecture," which were history, seductive drawing, utility, comfort, economy, serving the client, and structure.[465] Walter Gropius emphasized in his article "Eight Steps toward a Solid Architecture," published in 1954, that the architect should diagnose the client's real needs and give him a consistent building, gain competence in all fields of building to earn the client's confidence and the right to captain the team, and make better use of science and the machine to serve human life.[466] Saarinen undoubtedly shared this sentiment in his technology-based, client-oriented practice as he claimed: "From the miraculous potentials of engineering and science will come new possibilities, new materials and new problems. These will have to be absorbed."[467]

But whether the parameters of modern architecture were defined as currents, crutches or steps, the only solid base on which the practicing late modernists seemed to agree was the strong legacy of the modern movement and the prevailing uncertainty about the direction and form modern architecture should take among the intriguing possibilities the postwar climate and the emerging new technologies had to offer. "The architect must recognize that this is a new kind of civilization in which the artist will be used in a new and different way," Saarinen concluded about the architect's position in the postwar society, "He must be sensitive and adaptable to trends and needs; he must be part of and understand our civilization. At the same time, he is not just a mirror. He is also a co-creator and must have the strength and urge to produce form, not compromise."[468] It was evident that more than one architect, historian or modernist was needed to convince others of the need for modern housing, hospitals, office buildings and airports. More than one

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[462] *Saarinen 1957, 49.*

[463] *Saarinen 2006 (1959), 350.*

[464] *Saarinen 2006 (1959), 353.*

[465] *Johnson 1993 (1955), 190-192.*

[466] *Gropius 1993 (1954), 177-180.*

[467] *Saarinen 1953b, 114.*

[468] *Saarinen 1953c, 119.*

protagonist was needed to make people want modernization and the facilities it produced. It is then unsurprising to find that similar work was done by more than one practitioner, and conversely that while architects worked with similar questions their architectural vocabularies took various forms.[469]

Saarinen's fluent networking between locations, clients and collaborators was part of the new office culture in the corporate America, which increasingly imagined itself as a network of suburban housing and corporate headquarters outside of major cities. What made this change possible was the network of highways, and airways connecting workplaces to suburbs and major cities. Architects were giving form to the newly formed techno-environment as ambiguous quasi-objects and hybrids were increasingly questioning the meaning of the technological artifact traditionally defined by its lineage and place within large technological systems. The hybridization of objects, multiplication of viewpoints and gradual disintegration of large technological systems was transforming technology into complex networks within which traditional machines lost their precise spatial definition and relative autonomy. For instance, an aircraft could then be called a computer on wings, a node in a vast and expanding electronic network.[470] A statement by the Eero Saarinen and Associates from 1955 describes how he saw his role in forming this new modern environment of technology: “Architecturally the firm believes uncompromisingly in design based on modern technology and has been responsible for many innovations in materials and building techniques. But, eschewing any formula or vernacular, it also holds the strong conviction that every problem deserves its unique and individual solution.”[471]

Along these principles Saarinen’s laboratory produced alternative interpretations of postwar modernity that took the form of projects as varied as the TWA Terminal and the General Motors Technical Center. His research resulted in buildings that could be read as architectural statements similar to scientific statements. Typically such new statements about architecture are accepted only gradually, because the prevalence of a certain discourse in descriptions of architecture makes it difficult to discuss architecture with an alternative terminology. As Latour and Woolgar claim, once a statement begins to stabilize, it becomes a split entity; on the one hand the statement and on the other the object to which it refers. Gradually more reality is attributed to the object and less to the statement about that object until an inversion takes place and the object becomes the reason why the statement seems to have been formulated. Thus, even though the object first is nothing but a virtual image of the statement, the statement later becomes an image of that reality of objects.[472] This sort of inversed causality characterizes architectural statements such as Saarinen’s claims about modern architecture that gradually took the form of architectural objects, and is especially clear in the corpus of the architectural statements the company produced of individual projects. The buildings were at first only images of his statements, but when the buildings were realized, the statements were read

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[469] *MacKenzie analyzes technological development and culture in similar terms in MacKenzie 1990, 92.*

[470] *Picon 1999, 324-325.*

[471] Who is Who in Eero Saarinen and Associates *ca. 1955. Brochure by the office, 8.*

[472] *Latour and Woolgar 1986, 176-177.*

as images of them. Subsequently, Saarinen's buildings not simply embody, but actually *are* architectural statements. They are both: architectural objects and statements, material and image.

Based on this reasoning, reality is a consequence of the settlement of a dispute rather than its cause. The fact-like status of a statement is constructed by convincing others of that statement, which in the case of architecture means that buildings are constructed once others are convinced of their functional and aesthetic value.[473] Architectural modernism could then be interpreted as information construction, where every building becomes a statement that is increasingly difficult and costly to object to or alter. As in a scientific laboratory, the architectural laboratory then transforms any set of equally probable statements into a set of unequally probable statements. The set of statements considered impossible to modify constitutes what is referred to as reality or current architectural practice and vocabulary. It is through this kind of a process that architectural modernism became reality, a fact beyond reasonable reversal.

Saarinen's buildings are statements, which work as extensions of the network redefining architectural modernisms. In this process of settling the dispute about modernisms *actants*, including the architects, the buildings and the users of those buildings were constantly redefined and regrouped and the strength of the heterogeneous network, i.e. the credibility of the proposed modernism, measured by the durability of its various links until the proposed modernism became accepted as the dominant form of modernism. This network provides an architectural historian an entrance point into the narrative of the design before it began, before Eero Saarinen became "Saarinen" i.e. the architect represented in the canon of modern architecture, and before his terminal buildings became significant buildings in the history of modern architecture.

5.2. Expressing the Spirit of the Airport

In order to understand Saarinen's success in convincing others not only of the novel spatial organization of his airport terminals, but the imagery and experience of modernity they mediated, it is necessary to return to the three airports and analyze their individual design paradigms more closely. These three airports are architectural statements that perhaps most accurately demonstrate the kinds of innovations in materials and construction techniques the firm was able to produce with its research based approach to architectural problems. Furthermore, they demonstrate the kind of architectural imagery and materiality Saarinen produced with his architecture. The TWA Terminal is an example of "structural expressionism" that Saarinen employed to evoke the imagery of flight and enforce the corporate identity of that airline. Dulles International negotiates "monumentality" in relation to function and technology in order to solve the design problem of the jet airport and represent the nation and its primary values of democracy and capitalism, and Athens International reads as an essay of "(inter)national modernity,"

[473] *Latour and Woolgar 1986, 240-243.*

a complex experience of local modernity in relation to the established vocabulary of International Style modernism.

The design process differed in the three airport projects, but all of them may accurately be described as processes of negotiations. Saarinen separated problems for analysis, did most of his design work on study models and collaborated with architects, consultants and engineers to arrive at the final architectural statement. Lawrence Lessing, in a 1960 article, identified four distinct stages in Saarinen's working methodology.[474] First, the functional program was studied through exhaustive surveys of statistical data, work procedures, use patterns, human requirements and site features. In the Dulles project for instance, this phase took six months. Second, the expression of the program was determined based on the analysis of the functional needs, the site and the client. Working on study models the firm aimed to determine what kind of an architectural statement the building was going to make. The third stage of design defined the building's structure and materials based on mechanical considerations and engineering. New materials, ideas and components were studied in models and tested with mock-ups. The fourth stage was design, which generally began early but culminated only after the other three stages. Saarinen harmonized the elements as his design team built and rebuilt the master model until the architectural statement was "reflected in every single part, the choice of material, the detailing, the form."[475]

Eero Saarinen and Associates got involved in airport planning when it was commissioned to design its first airport building, the Trans World Airlines Terminal in 1956.[476] According to Charles C. Tillinghast, Jr., The President of TWA, Saarinen was hired because of his reputation as "a creator of structures that achieved more than simple functional excellence. They were aesthetic monuments as well that conveyed feeling and

[474] *Lessing 1960, 96.*

[475] *Saarinen, Eero, 1959. General Statement about Architecture (Eero, dictated weekend of January 3, 1959), 3. General writings, box 28, folder 118. Series II. Professional Papers. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[476] *Trans World Airlines was one of the pioneering American airlines. One of its parent companies, Western Air Express, had been operating mail flights between Los Angeles and Salt Lake City since 1925. However, TWA was officially established when Standard Airlines, Maddux Air Lines, and Transcontinental Air Transport merged with Western Air Express on October 1, 1930 to provide coast-to-coast all-air service across the United States under the corporate name of Transcontinental and Western Air, Inc. The name was later changed to Trans World Airlines to reflect the global stature of the airline. TWA operated Ford Trimotors and later the Douglas DC-1, the DC-2, the DC-3, and the Boeing Stratoliner. In February 1946 it became the first airline to operate the Lockheed Constellation. After the war TWA was awarded international routes by Civil Aeronautics. Within months after its initial flight to Paris on February 5, 1946, TWA had extended its service to several European cities, North Africa and India. In 1950 TWA was also certified to fly to London and Frankfurt. It inaugurated jet service on American routes on March 20, 1959 and on international routes on November 23, 1959. Oldridge 1962, 10, 17.*

emotion, and stirred something within those who looked upon them."[477] According to Saarinen the aim was: "One, to create, within the complex of terminals that makes up Idlewild, a building for TWA which would be distinctive and memorable. Its particular site –directly opposite Idlewild's main entrance road and at the apex of the curve in the far end of the terminal complex –gave us the opportunity of designing a building which could relate to the surrounding buildings in mass, but sill assert itself as a dramatic accent. Two, to design a building in which the architecture itself would express the drama and specialness and excitement of travel."[478] This was what Saarinen aimed to achieve with the exuberant form of the terminal and the interior in which "the human being felt uplifted, important and full of anticipation."[479]

Research on existing airports and their anticipated future formed the first stage of the design and determined the functional program. Saarinen began the design process in February 1956 "by collecting data on planes and passengers, touring existing terminals with notebooks and stopwatches in hand, arranging plane positions on a plan of the tight wedge-shaped site [TWA needed 14 jet-size positions], and conferring with planners of TWA and the Port of New York Authority."[480] Research was carried out at least in Baltimore, Chicago, Dallas, Philadelphia and San Francisco. Two influential airport terminals for TWA's design were the then newly opened and praised International Arrivals Building by SOM and, in particular, the Lambert St. Louis Airport by Yamasaki, Leinweber & Associates, which sported an innovative, vaulted structure. Saarinen was naturally aware of the St. Louis Airport, which received First Honor Award from the AIA in 1956, but he was critical of the long walking distances created by passageways and the concealed exterior supports utilized for the vaults. Another likely influence in terms of form giving was Jorn Utzon's Sydney Opera House as Saarinen served as a member of the competition board.[481]

The second stage of design formulated the architectural statement and the expression of the program. Saarinen made a large number of models in different materials and various scales ranging from 1:5,000 site models to 1:1 models for full size details. However, the ¾-inch scale was the most important one.[482] In order to work on such a number and large-scale of models, the office even expanded to a garage at the corner of Woodward Avenue

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[477] *During the design of the TWA Flight Center there were several changes in the personnel of TWA. The building was actually commissioned by Ralph Dawson, but by the time the building was completed he was no longer the President of TWA. Tillinghast 1962, 9.*

[478] Eero Saarinen on His Work *1962, 60.*

[479] *Saarinen Aline, 1962. Designer Sought Spirit of Travel in Design of Trans World Flight Center. TWA press release 051562. Press materials, box 330, folder 932. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[480] *TWA's Graceful New Terminal 1958, 79. The sketch Aline Saarinen refers to was only done after the article on* Time *magazine (July 2, 1956).*

[481] *Saarinen 2006 (ca. 1958-59), 343-344.*

[482] *Borcherdt 1960, 2; Papademetriou 2001, 183.*

and Long Lake Road.[483] The first scheme was a saddle-shaped concrete shell supported on four points located close toward the center of the building, but the study model revealed that the proposed building would not follow the curve of the street nor express the movement of passengers through the terminal. Furthermore, the shape would have been working against the structure, because the great cantilevers at each end of the shell had resulted in an exceptionally heavy edge beam. The work thus continued with tearing apart the rough cardboard model; breaking the long axis of the roof so that the building's form followed the curve of the street; spreading the field-side supports to coincide with the tunnels to the satellites; and separating the four shells with skylights in order to define the roofline.[484]

Hence, the work done on study models resulted in a structure, which consisted of four interacting barrel vaults of slightly different shapes, supported on four Y-shaped columns (fig. 5.6). At either side of the main building was a one-story wing. These housed facilities for ticketing and baggage handling. "The shapes of these vaults were deliberately chosen in order to emphasize an upward-soaring quality of line, rather than the downward gravitational one common to many domed structures," explained Saarinen, "For the same reason, the structural shapes of the columns were dramatized to stress their upward-curving sweep. The bands of skylights which separate and articulate the four vaults increase the sense of airiness and lightness."[485]

The third stage of design translated the architectural statement into a feasible structure through negotiations. The team creating the TWA Terminal included not just Eero Saarinen and Associates (Kevin Roche, Cesar Pelli, Edward Saad and Norman Perttula were among those assigned to the project) but structural engineers Ammann & Whitney, mechanical engineers Jaros, Baum and Bolles, lighting consultant Stanley McCandless, acoustical consultants Bolt, Beranek and Newman, and contractor Grove, Shephard, Wilson & Kruge, Inc.[486] Collaboration with engineers was an essential part of Saarinen's research-oriented design methodology, since developing technologies beyond their current limits would not have otherwise been possible. In fact, the kind of collaboration that took place in the Saarinen office shows how architectural practice involves scientific and technological knowledge. Hence, it questions the assumed divorce between the three fields. As Antoine Picon has pointed out, science is not the only true form of knowledge and the design of technological artifacts involve arbitrariness not unlike the kind experienced in architectural design. Science, technology and architecture are then similar and interconnected cultural products within larger cultural patterns.[487] This is especially true of the 1950s and 1960s when rapid technological development was closely linked to progressive modern architecture.

One of the interests that the postwar generation of modernists explored was the expressive potential of thin shell construction. The thin shell is "a rigid curved membrane

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[483] *Pelkonen & al. 2006, 335.*

[484] *TWA's Graceful New Terminal 1958, 80.*

[485] Eero Saarinen on His Work *1962, 60.*

[486] *Idlewild: New York International Airport 1961, 151-190.*

[487] *Picon 1999, 309-311.*

in which all stresses, compressive or tensile, are continuous and three-dimensional in the skin's structure, and are conducted to the ground through a curvature by suitable supports."[488] In the 1950s the hyperbolic parabola was very popular because its formwork could be made from straight timbers. The geometric form also conformed to the purist view that a thin shell had to be a thin curved shape that represents a precise mathematical relationship and is properly supported. But, as the specialist in thin shell construction Christopher Hart Leubkeman argues, geometrically generated shells did not completely utilize the strength inherent in the structural form. Furthermore, these shells faced a problem of edge disturbance, which meant that along the edges the uniform distribution of the membrane stresses began to be distorted. Stiffening the structure with an edge beam was a common solution to this problem. In the case of the TWA, the structure of the terminal actually consisted of four lobes of segmental domes. Each lobe stood alone on two supports but they met in the center where a hidden keystone provided a third structural support. The two large lobe-domes consisted of 19-inch-thick segmental barrel shells that were leaning against each other along the ridge and their force was resisted by the varying width of the edge beam.[489]

Ammann & Whitney, the structural engineers of the TWA Terminal, were at the forefront of thin shell construction and Saarinen collaborated with them on a series of structures including not only the TWA but also the spherical segmental dome of Kresge Auditorium and the suspended roofs of Yale Hockey Rink and Dulles Airport.[490] "Saarinen was a shape-giver," recalls Abba Tor, the structural project engineer in the Ammann & Whitney team for the TWA Terminal, "He was always searching for the right form for the building involved… and sometimes the structural aspects of his work did not easily fall into logical engineering solutions." This was the case with the TWA Terminal's 1.4acre roof, which was to be built as one continuous undulating shape. "We had to convince him and his people that the roof needed joints and separation because it was not possible to have such a large area of concrete poured without the concrete shrinking, which would lead to cracking later on."[491] As a result, the final design included joints with skylights between the shells. Therefore, while Saarinen's decisions may seem more formal and aesthetic than structural or functional, they were, in fact, a result of negotiations between several actors and the final design of the TWA Terminal was a compromise between formal expression and functional logic, engineering principles, and Saarinen's aim to expand the vocabulary of modern architecture.

The structural form of the building was carried through the entire building in the fourth stage of the design process. The curvilinear theme was varied in the interior so that the building formed a "total environment where each part was the consequence of another and all belonged to the same form-world."[492] To achieve this, the immediate area around the front entrance was studied in interior models that finally covered one-half of the entire

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[488] *Stamats 1961, 4-6.*

[489] *Leubkeman 1992, 106-108.*

[490] *Leubkeman 1992, 108; Saarinen 2006 (ca. 1958-59).*

[491] *The Art of Engineering: Abba Tor in an interview with Johanna Weber 2008.*

[492] *Eero Saarinen as quoted in Saarinen's TWA Flight Center 1962, 133.*

space. Because the building was symmetrical, the whole space could then be imagined by placing a mirror on the end of the model at the center axis. The area around the central stairway was remodeled several times explained Saarinen: "Gradually we evolved a more flowing line for the bridge connecting the balconies, the stairways leading to them on each side, and the surfaces around this stairway."[493] The rest of the space flowed from this center anticipating and organizing the movement patterns of passengers. Columns on each side of the entrance were studied in specific models, where heavy wire described the thrust of each shell from a point of application in the shell to the range of application at the foot. Light wire sections around them were used to define the area needed for concrete and steel enforcing and, finally, a skin of light cardboard converted the model into a solid volume. "One of the happiest days was after we had worked out the supports in model form," described Saarinen, "Finally we were able to make drawings of what we actually had. In these drawings we found that the support plans were marvelous-looking things, showing forms that could never have been arrived at on paper."[494]

After the desired form was defined through the model work, the three-dimensional shapes had to be *translated* into construction drawings. This was not a minor undertaking and involved techniques more common in pattern making and contour surveying. The architect provided the contractor Grove Shepherd Wilson & Kruge with some 130 architectural and structural drawings based on the actual models, photographs of them, and mathematical calculations. Conventional plan and elevation drawings would not have given enough dimensional information about the complicated shapes. Instead, the contractors had to work with "contour maps" i.e. drawings where, for instance, the horizontal section of the buttress was supplemented by contour lines indicating the progressive shape of the buttress at 1-foot intervals (fig. 5.7). These were carefully analyzed with elaborate computations in order to translate them first into some 200 drawings and then into more than dozen assembly drawings, which the carpenters could actually use to construct the formwork.[495]

The process of construction involved elaborate teamwork and continuous negotiations among the various crafts. "Each construction phase was preceded by detailed briefings and discussions, seeking to anticipate problems and decide on their solution early,"[496] and engineers were required in roles that would normally be filled by foremen. On the other hand carpenters, who did not possess any special skills, were hired directly from New York's hiring hall. Ground was broken in June 1959 and followed by the construction of the wooden form. Then 1,500,000 pounds of reinforced steel was interlaced atop the form and, starting in September 1960, 10,000,000 pounds of concrete poured over it. Various

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[493] *Eero Saarien as quoted in TWA's Graceful New Terminal 1958, 82.*

[494] *The design methods used in the Saarinen office were then more akin to car or airplane design than to any conventional methods of architectural planning. Eero Saarinen as quoted in TWA's Graceful New Terminal 1958, 84.*

[495] *Shaping a Two-acre Sculpture 1960, 118-123.*

[496] *Complexities of TWA Flight Center Best Realized by Builders 1962. News from TWA press release 050262, 2. Press materials, box 330, folder 932. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

pouring positions were supervised from a central observation point during the complicated and uncorrectable process that lasted for weeks (fig. 5.8). Finally, the wooden form was removed in November 1960. Astonishingly, the final form deviated only ¼ -inch from the architect's initial plans.[497]

The impressive roof weighted 11,500,000 pounds and covered one-and-one-quarter acres. Its thickness varied from 44 inches at the keystone center, where the four vaults met, to eight inches at the edges, and three feet at the buttresses. The building included some innovative construction details such as the green-tinted glass wall panels that were set at an angle to obviate glare and held in aluminum framework by neoprene structural glazing gaskets, which Saarinen had used for the first time in the General Motors Technical Center. The beaklike extension at the front was actually a rainwater drain, and the futuristic centerpiece hang from the Flight Center's roof functioned as the public address system.[498]

In the final scheme outbound passengers were checked in and ticketed on one side of the terminal building while incoming passengers reclaimed their baggage on the other. Operational functions were located on the lower floor. The great vaulted space of the main hall was dominated by the grand stairways leading to the second level and the circular waiting lounge overlooking the airfield (fig. 5.9, 5.10, 5.11, and 5.12). Departing passengers progressed through the terminal along a tunnel to the satellite building or the Flight Wing as it was called. This 307-feet enclosed walkway was raised off ground to permit ground ramp traffic below it. Ground level of the Flight Wing was reserved for aircraft servicing and operations procedures while the upper floors served passengers. Atop was the TWA control tower, which controlled aircraft operations for efficient and coordinated service. Fourteen Jetways (telescoping loading bridges) served the seven aircraft positions around the Flight Wing. Passengers boarded and disembarked the aircraft via these bridges, which connected the aircraft to the satellite or one of its two departure lounges located at the end of these glass-enclosed corridors (fig. 5.13).[499]

Saarinen had plans for motorized passenger walkways but these were not realized. However, the Flight Center (as TWA called the terminal) featured several other novel

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[497] *Complexities of TWA Flight Center Best Realized by Builders 1962; Shaping a Two-acre Sculpture 1960. Pictures were taken by Balthazar Korab. Additional Material, box 330, folder 932. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[498] *Fact Sheet, Trans World Flight Center 1962. Press release 050262. Press materials, box 330, folder 930. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library;* TWA Welcomes You to the Trans World Flight Center, New York International Airport. *Undated TWA Brochure. Press materials, box 330, folder 934. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[499] *Control Tower at TWA Flight Center Directs Operations 1962. News from TWA press release 050162. Press materials, box 330, folder 932. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Idlewild: New York International Airport 1961; Saarinen's TWA Flight Center 1962, 134.*

solutions for efficient check-in, rapid baggage delivery, and accurate flight information to ease congestion, speed up passenger handling, and support TWA's commitment to on-time departures. Twenty-five check-in positions were linked by a closed circuit television system and equipped with Triner computer baggage scales that calculated overweight charges. Solari Datavision system information boards displayed public flight information with large, easy-to-read numbers and lettering controlled by personnel coordinating flights. Incoming baggage was carried on conveyors to one of the three baggage carousels that were able to handle over 300 bags in 20 minutes, so that luggage would be awaiting on the carousel by the time passengers reached the baggage claim area. The carousels were only ten steps from the curbside, where taxis and cars were waiting for the arriving travelers.[500] As operations expanded, Kevin Roche John Dinkeloo and Associates added a second tunnel and satellite building in 1970. Although located where Saarinen had intended a second satellite, it was not realized according to Saarinen's original plan.

The TWA building was a total environment where each part was a consequence of another and the curvilinear theme was subtly varied in the shapes of the curtain wall, staircase, information booth, flight board and ticketing wing. The whole space was arranged around the studied crisscrossing and spiraling circulation patterns of passengers and these curving and sweeping forms were carried throughout the entire building from the minute detail of the tile work to the overall sculptural form of the building. Furniture elements seemed to grow organically from the overall shape of the interior and the whole design was integrated by a subtle color scheme. The concrete surfaces were finished in white and pale grey, contrasted by carmine, the color of TWA, which was used as an accent color in the signage, upholstery and carpets. Small (½-inch), round, oyster white Japanese ceramic tiles covered floors and wall surfaces, including the vaulted undersides of some of the balconies, which blurred the distinction between ceiling, wall and floor.[501] The curved ceiling was sprayed with a mixture of asbestos for sound absorption. The main waiting lounge of the Flight Center was a conversation pit that offered broad views of the airfield (fig. 5.14). Lounges and restaurants, which were situated on the mezzanine overlooking the waiting area, portrayed themes related to TWA's international destinations and were named accordingly as the Lisbon Lounge, London Club, and Paris Café. Seating in the lounges was built into the structure and had a second function of establishing and controlling traffic patterns around the enclosed resting areas. The interior themes of the restaurants were planned and designed by Raymond Loewy/William Snaith, Inc.[502]

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[500] *New Innovations Improve Services at Idlewild's Trans World Flight Center 1962. News from TWA press release 050162, Press materials, box 330, folder 932. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[501] *Tiles were made by Ina Seito Manufacturing Co. of Tokoname, Japan and imported by Port Morris Tile & Terrazzo Corp. TWA's Tiny Tiles 1962, 57.*

[502] *Saarinen's TWA Flight Center 1962, 133; One Family of Forms 1962, 158-165; Trans World Flight Center's Four Restaurant Facilities Reflect International Theme 1962. Press release 051062, Press*

The airline and the architectural office used the building and its imagery cleverly in advertisement and marketing (fig. 5.15).[503] Tillinghast saw the Flight Center as a monument belonging to an age "when jetliners span oceans and continents in hours; when men of great courage penetrate ever deeper into the unknown realms of space; when barriers to man's achievement are surpassed almost as quickly as their existence is recognized."[504] A film by Charles Eames and photographs by Ezra Stoller enforced this exciting, futuristic imagery and expressed the drama of flight. It was then hardly surprising that *Architectural Forum* and *Architectural Review* used the phrase "concrete bird" although Saarinen denied this metaphor and claimed it purely coincidental.[505]

In the media the building received mixed reviews. While the majority praised its soaring form and expression of emotion and movement, its form was also criticized. "Far from the programme suggesting the forms, the forms have suggested an entirely spurious interpretation of the programme," claimed Alan Colquhoun in one of the better-known critiques, "But it is not the idea of air travel that Saarinen is expressing. Rather is he interested in expressionist forms per se, and particularly those which, like the forms of aircraft, spread out in cantilevers and appear to be in the act of taking off." In his opinion: "One imagines that the emotionally battered traveler wants nothing more than to attain the relative terra firma of the plane, where at least he can be sure that his Scotch will remain orthogonal to his own axis when the plane itself is describing expressionist patterns in the sky."[506] *Architectural Review* further reported that voyagers had described "the scale of TWA interiors as mean, minute, toylike, sub-human or even 'a rat-maze,'"[507] but Edgar Kaufmann, Jr. claimed that Saarinen had created "one of the few major works of

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materials, box 330, folder 932. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.

[503] *See for instance marketing brochure from 1962 called* Winged Gateway to the World of Flight *(ca. 1962), which advertises the terminal as "Most beautiful in all the world –so functional too!" and as "A passenger's dream" and with the phrase "Under soaring wings… two acres of advanced features and facilities." The brochure is filled with beautiful renderings illustrating the glamour of flying with TWA. Another brochure introduces Eero Saarinen's terminal as one of the Jet Age Air Terminals TWA operates.* Jet Age Air Terminals TWA *1961. Press materials, box 330, folder 934. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[504] *A Message from Mr. Charles C. Tillinghast, Jr., President of Trans World Airlines 1962.*

[505] *The Concrete Bird Stands Free 1960, 114-115; Concrete Bird: Progress at Idlewild 1961, 77; Inside the Bird 1963;* Eero Saarinen On His Work *1962, 60. Yet a press release from November 13, 1957 states "TWA Terminal suggests the flight of a giant bird". Saarinen Captures Spirit of Flight in TWA Structure 1957. Press release, November 13, 1957. Press materials, box 330, folder 932. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[506] *Colquhoun 1962, 465.*

[507] *Forget the Bird: TWA Appraised 1962, 306-307.*

American architecture in recent years that reaches its full stature *as an interior*."[508] While the TWA Terminal attracted both praise and criticism, it was never found insignificant.

5.3. The Jet Airport

The design process for the Dulles International Airport was similar, but more complicated, as the architectural problem was not limited to one unit terminal but involved the entire jet airport. Dulles occupied a site of approximately 10,000 acres in Chantilly, Virginia, located 27 miles from Washington. President Eisenhower and his Special Assistant E. R. Quesada selected this site after local opposition blocked land acquisitions on an alternative site in Burke, and the Air Force declined to allow the conversion of Andrews Air Force Base into an international airport. Finally, Congress appropriated $12.4 million for the airport in August 1957 and land acquisitions began in January 1958. Ammann & Whitney was selected as the prime contractor for the airport design in May 1958 with a team including Eero Saarinen and Associates chosen for the design of the terminal building, control tower and service buildings (with architects Kevin Roche, Kent Cooper, David Jacob, Paul Kennon, Norman Perttula and Warren Platner assigned on the project); Burns and McDonnell for the design of the mechanical, electrical and utility installations; and Ellery Husted as the master plan consultant.[509] Lighting consultant Richard Kelly, landscape consultant Dan Kiley, and Landrum and Brown, who were responsible for the traffic and economic planning for the airport, supported this primary team. Construction of the airport began on September 2, 1958 and it opened for operations on November 19, 1962. It was named for John Foster Dulles, who served as Secretary of State from 1953 until 1959.[510]

For the design of the Dulles International Airport, Saarinen was actually "not asked to grapple with the problem of a jet-age terminal beyond the question of pure architecture," but he believed that a fundamental analysis of the whole design problem was his

[508] *Kaufmann 1962, 86-93.*

[509] *Dulles International Airport. Federal Aviation Agency FAA fact sheet, undated (probably early 1962), ii, 1. Press information, box 497, folder 1366. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library. Justification for the site selection is explained in Site Selection Study, Additional Airport for Washington, D.C., prepared by Greiner-Mattern, Assoc., 1106 North Charles Street, Baltimore 1, Maryland, dated December, 1957. Programs and government reports, box 497, folder 1376. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[510] *Dulles International Airport 1963, 110; Dulles International Airport, Dedication Program, November 17-18, 1962. Press information, box 497, folder 1365. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

responsibility.[511] Therefore the firm again carried out extensive time-and-motion studies at Washington National Airport, Willow Run in Detroit, O'Hare Airport in Chicago, Love Field in Dallas and Lambert Field in St. Louis, and researched how weather conditions and activity peaks affected apron occupancy and runway operations. They measured the lengths of auto ramps, and ticketing and baggage claim counters; charted passenger volume per minute ratios at these counters; and developed time and motion studies of the entire enplaning and deplaning sequence.[512] The designers studied the advantages and problems associated with the centralized and the decentralized airport scheme and were especially concerned with comparing the mean distances from terminal entrance to airplane. "We sent out teams with counters and stop watches to see what people really do at airports, how far they walk, their interchange problems," Saarinen office explained in the project statement, "We analyzed special problems of jets; examined schedules, peak loads, effects of weather. We studied baggage handling, economics, operations, and so on. We reduced this vast data to a series of about 40 charts."[513] These concept studies and diagrams were then utilized to rationalize the design and structure of the airport (fig. 5.16, 5.17 and 5.18).

It was discovered that the median walking distance in the centralized airport was 1400 feet compared to 650 feet in the decentralized airport. Interchange among airlines required a walk of 3400 and 4500 feet respectively. The specific airport data was 1350 feet in Dallas, 775 in Detroit, and 1010 in Los Angeles (fig. 5.19). But as Dulles was the first jet-designed airport, it was acknowledged that these comparisons were not completely relevant.[514] During the research phase Saarinen followed the guidelines discussed in period journals and design manuals and engaged in extensive time and motion studies that were becoming increasingly common in airport design. As Peter Papademetriou and Antonio Roman have suggested, Saarinen's systematic approach might have been influenced by his internship in Normal Bel Geddes' office in 1938, as Geddes'

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[511] *Saarinen as quoted in Our Two Largest Airports: Dulles International Airport 1963, 90*; Eero Saarinen on His Work *1962, 92.*

[512] *Enplaning begins when the passenger arrives at the terminal building, deplaning at the moment the plane touches down on the runway. Eero Saarinen Papers hold such material as presentation panels, concept studies and diagrams (analyzing e.g. organization of airport functions; terminal areas and facilities; passenger movement patterns; walking distances; runway occupancy times; taxiing costs; and landing, turnout, and plane position requirements for various aircraft), studies conducted by IATA and other aviation specialists, and planning manuals for airports. Airport case studies, analysis and research, boxes 460-462, folders 1288-1305, box 703, folder 223; Research files, boxes 497-499, folders 1378-1391, 1403-1409. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[513] *Eero Saarinen's Statement on the Design as quoted in Dulles International Airport 1963, 103.*

[514] *Facts about the Design of the Washington International Airport 1959. Press release, April 17, 1959, 7. Press information, box 497, folder 1367. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

methodology relied similarly on quantifiable data and functionality studies.[515] Furthermore, in a similar manner to Saarinen, Geddes could be described as a stylist, whose rational, systematic approach was somewhat cosmetic.[516]

To determine the best layout for a jet airport, the design team studied different types of aircraft in great detail. The office collected marketing brochures and technical information about all aircraft operational at the time or entering the market in the near future (new jets released in 1958 included the Comet 4, TU-104, Caravelle, Boeing 707, Douglas DC-8, Bristol 200 and Convair 880). They principally used technical drawings for the Boeing D6-1705, Douglas DC-8, Lockheed 1649A, and Convair 880 in architectural planning. They made a taxiing analysis of piston engine aircraft, executive planes and jets; studied loading and takeoff speeds; and charted comparative lengths of runway these aircraft used in takeoff and landing. The final apron and runway scheme was partially determined by this data, while wind conditions and expected air traffic patterns were other factors influencing the design.[517] In June 1958 Saarinen, Roche and consultants working on the Dulles project even visited the Boeing factory in Seattle and boarded the Dash 80, prototype of the Boeing 707, for a flight around the city (fig. 5.20)[518]. To gain information on the specific traffic patterns and activity peaks in Washington they measured terminal apron occupancy time patterns for all scheduled flights of all airlines at Washington National Airport on a typical week day in different weather conditions. This analysis was important since quantities of operational facilities such as ticket counters were based on individual airline peaks, but quantities of passenger facilities on composite peaks.[519]

This research determined the functional program of the airport. Planners concluded that Dulles needed two North/South runways, which were 11,500 feet long, 150 feet wide, separated by 6,700 feet and overlapped 50 percent of their length. These were complemented by a 10,000 feet West Northwest-Southeast runway, and connected by parallel taxiways and high-speed turnoffs. Based on traffic projections it was estimated that a terminal building with sixty gates would be required by 1975. The conventional gate to plane loading method suggested a decentralized sub-terminal scheme. However, research showed that in 1958, America’s 48 million annual airline passengers were already walking an average of 650 feet from their parked cars to the ticketing counter and another 950 feet to their airplanes. Jets had to be positioned at some distance from the main terminal because of their noise, blast and fumes, and this increased walking distances

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[515] *Geddes had also published a similar description of the St. Louis Lambert Airport. Roman 2003, 111; Geddes 1932, 79-121; Peter Papademetriou Discussion with Thomas Fisher 1992, 102-104.*

[516] *I thank Professor David Brownlee for pointing out this quality of Geddes’ methodology.*

[517] *A New Airport for Jets 1960, 179; Research files, boxes 497-499, folders 1378-1391, 1403-1409. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[518] *Pelkonen & al. 2006, 337.*

[519] *A New Airport for Jets 1960, 179. Airport case studies, analysis and research, box 461, folder 1299. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

even further along the expanding finger structures.[520] Thus, it was concluded that an international airport of this magnitude would require a novel organizational principle. "We found that there were three critical areas in designing an airport," Saarinen explained, "One was the time and inconvenience of getting passengers to and from planes; another was the heavy cost of taxiing jet planes; the third was the increasing need for greater flexibility in operations and servicing of aircraft." These defined the functional program of the airport, but architectural expression of the jet-age airport had to be "essentially non-static, expressing the movement and excitement of travel."[521]

The mobile lounge scheme solved the three critical problems defined by Saarinen. It approached the waiting lounge as an integral mobile part of the terminal and thus offered a new organizational principle for the modern airport. In this scheme airplanes were separated from the building and parked around service units located on the apron. Passengers were then transported directly to the planes with the mobile lounge, which was a developed version of the bus systems employed at London-Heathrow, Amsterdam-Schiphol, and Frankfurt Airport (fig. 5.21). The medial walking distances were shortened to 350 feet from curb to plane, and 950 feet when changing from one airline to another. Interestingly, the idea of the mobile lounge had already surfaced when the firm was researching jet aircraft terminals for the TWA Terminal. "There were no examples of any architecture that had been developed for them [jet aircraft]," describes Roger Johnson, "I happened to find in an obscure magazine the mobile lounge concept. It was being promoted or envisioned by a Swiss architectural firm." This material then resurfaced when, after some eighty studies on the airport scheme, it was decided that parts of the terminal building itself should be mobile, lounges wheeling to and from the aircraft parked on the apron.[522]

The mobile lounges were the largest passenger carrying vehicles ever built to operate on rubber tires. They were sixty-feet long and fifteen-feet-wide and accommodated seventy-two seated passengers along with twenty-six standees. The lounges lined up on the field side of the terminal to pick up passengers, and their well-designed interiors offered agreeable environments for waiting. They could be driven from both ends and had twin engines of 172 horsepower each. Pneumatic units at the front of the lounge were

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[520] *Taxiing cost was estimated to be as high as $50 per minute. It was anticipated that 65 percent of the operations would be from South to North and therefore simultaneous operations were permitted when the easterly runway was used for landing while the westerly was used for takeoffs.* Dulles International Airport Master Plan Report *1964, 9-15; Dulles International Airport Terminal Building fact Sheet, FAA News, Undated, 7. Press information, box 497, folder 1367; Comparative passenger walking charts. Slides: Presentation #1 and #2, box 499, folders 1401-1402. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; A New Airport For Jets 1960, 176-179.*

[521] *When the building received First Honor, Saarinen's statements were published in The 1966 A.I.A. Honor Awards 1966. 37.*

[522] *Roger Johnson recollection.* Saarinen Swanson Reunion Proceedings *2001, 32. This concept was somewhat similar to the one proposed by Victor Gruen and Edgardo Contini in* Progressive Architecture*. Tomorrow's Airport 1957, 108-110.*

adjustable to align with various heights of aircraft entrances, and the lounge was pressed against the airplane fuselage to form a sealed connection (fig. 5.22).

The mobile lounge was designed to mate with all the types of four-engine aircraft that domestic and international carriers were using at the time of the planning or in the foreseeable future. As per FAA requirements the mobile lounge prototype was tested as thoroughly as a new aircraft to be certified by FAA. Thus, tests were run 24 hours a day, six days a week and the lounge mated a minimum of 200 times with the mockups of the terminal and the four most difficult aircraft prior to connecting to an actual aircraft. In the Cold War climate the lounge could "deliver to all commercial jets, large or small, except the high Russian TU-114 which has not yet come into Dulles." Financially, the considerable cost of the mobile lounge was to be offset by the elimination of finger structures and adjustable loading ramps. Their maintenance and operational cost was likewise to be balanced by savings in aircraft servicing and the lessened need for taxiing, special positioning and pinpointing of planes at conventional passenger gate. Individual airlines did not need to own and maintain lounges as these were allocated to them according to their schedules and peak hour operations. Thus, the mobile lounge offered a brilliant solution to the organizational problem of the modern airport.[523]

Importantly, the mobile lounge concept freed the terminal from the constraints imposed by the aircraft and allowed it to become a monumental structure hovering over the landscape between the parallel runways. The monumentality of the terminal was inherent in the structure, which had both functional and aesthetic value. "We have tried to give the building a monumentality," claimed Saarinen, "not in the customary rigid form, but in a dynamic quality appropriate for the aircraft industry and as an entrance to this country for foreign visitors."[524] Aesthetically the terminal building was essentially a temple of aviation, which conveyed something of the stateliness and dignity of federal architecture. Its form was a "hammock hung between two rows of concrete trees," which evoked the image of a tent accommodating the nomads of the jet age.[525] The imagery of nomadic travel followed that of heroic flight evoked at the TWA Terminal (fig. 5.23).

Models were again used to determine the structure and the architectural expression of the building. "In the course of Friday until Monday 14 people worked on the project and built the platform up about 30 inches," Raymond Bean, who worked in the office 1956-60, described one weekend of activity. He continued: "We put a mirror against one wall and

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[523] *More than 100 designs were investigated before the final selection. To make the journey more agreeable, passengers could smoke inside the lounges and there was music piped in. Facts About the Design of the Washington International Airport 1959, 4-5; The Mobile Lounge Fact Sheet, FAA News, ca. 1962, 1-10. Press information, box 497, folders 1366-1367. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Mobile Lounges Win Approval After Year's Test 1963.*

[524] *Eero Saarinen as quoted in A New Airport For Jets 1960, 181.*

[525] *Dulles International Airport Terminal Building fact Sheet, FAA News, undated, 4. Press information, box 497, folder 1367. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; For later interpretations see Martin 2006, 79; Roman 2003, 117.*

built I think four modules at three-quarter inch scale. The structure was about 60" tall in scale… When Eero returned… he walked into the conference room, among all the debris lying all over the place, and sat down at one of the stools, picked up a mag knife and went to work. Kevin followed in about that time and they talked back and forth. Aline would say something about it, and then Kevin would make a comment, and Eero would nod noncommittally… Eventually, illumination became an issue and they brought out a lighting engineer. He wired each circuit of lights into the model while we incised the columns. Eero spent about three days closeted in there with the engineer, playing on the rheostats to determine what the illuminations would be, just on a trial-and-error basis. People from the design team were standing around with light meters taking illumination levels and then transcribing them onto drawings."[526] Hence, the design evolved through negotiations that Saarinen managed as a "heterogeneous engineer" and various professionals were brought in his design laboratory to work on specific problems.

The structural system was based on 40-by-150-feet bays, derived from the spatial requirements of two mobile lounges and related services such as ticket counters, baggage handling facilities, and concessions. As two mobile lounges were required to carry passengers to a Boeing 707, each unit was virtually self-contained and able to handle all necessary functions related to the departure of one aircraft. The original terminal was planned to accommodate twenty-four mobile lounge positions and it was expected that by 1975 fifty-six such positions and additional sixteen bays would be required. Hence, it was anticipated that the 600 feet long building would be doubled by 1975 making the initial building the central part of a 1200 feet long, repetitive and symmetrical façade.[527]

Originally the terminal was 600 feet long and 150 feet deep. It had one concourse for departures and another level below it for arrivals and baggage handling, separating enplaning and deplaning (fig. 5.24). A two-level vehicular approach ramp served as the base of the building. Access for departing passengers was on the upper level ramp while deplaning passengers and buses used the lower level and access to parking was provided on a separate ramp. The ground floor was basically a concrete slab on grade. The colonnaded departure concourse rose above it and had an impressive cable-tensioned roof slung between two rows of columns placed 40 feet apart. These columns were 65 feet tall on the approach side and 40 feet tall on the airfield side. They sloped outward to counteract the pull of cables, penetrated through openings near the edges and curved downward to catch the suspended roof from above. Frame sections were of glass tilting off the vertical and placed in aluminum framing. The dramatic curved centenary roof created an expansive open area uninterrupted except for a massive sculptural central drainpipe, which could carry 12,500 gallons of roof water per minute emptying it into a man-made

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[526] *Raymond Bean recollection,* Saarinen Swanson Reunion Proceedings *2001, 37.*

[527] *Dulles International Airport Terminal Building Fact Sheet, FAA News, undated, 5. Press information, box 497, folder 1367. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; A New Airport For Jets 1960, 181-182.*

lake nearby.[528] To maintain the openness ticketing counters, restrooms and concessions were housed in low kiosks. These service modules could easily be expanded, moved or reconfigured in response to changing operational requirements (fig 5.25).[529]

The vertical and strikingly geometric form of the control tower contradicted the modern yet monumental mass of the terminal and was situated so as to provide a progression of views in a changing relation to the terminal as one approached the airport. This 177 feet high tower was connected to the terminal by a low concrete and glass structure, which accommodated an observation platform and a restaurant. Several levels of control rooms were situated below the control tower cab and the sphere atop housed the airport surface detection radar. The height of the tower was determined by the fact that the eye level of the controller in the tower cab had to be 160 feet above average apron elevation to permit undistracted view of the airfield.[530]

All other structures and facilities at the airport were visually subordinate to the terminal and control tower and the entire site was integrated by Dan Kiley's landscape plan. Service buildings were constructed along specific service avenues to the east and west of the terminal. Satellite structures placed on the apron were not intended for passenger use. They became midfield terminals only later when the volume of travellers outgrew the terminal. Initially these satellites contained facilities for disposal of plane sanitary waste, cabin cleaning, in-flight meal service, and replacement of air conditioning units. Clad in enameled aluminum and painted in K-48 grey these modest, low, rectangular flat roofed buildings gave a uniform and aesthetic expression to the otherwise utilitarian structures. Saarinen and the design team prepared a master plan, which controlled future expansions and determined the location and dimensions of additional buildings at the airport.[531] "There was a crucial problem of disciplined, long-term and imaginative zoning," explained Saarinen, "Of special importance was the problem of some kind of continuing control in the terminal and its surroundings."[532] Unfortunately the plan, which included signage, lighting and landscaping, has been followed only partially.

The structure and materials of the terminal building and, in fact, the design of the entire airport were defined in negotiations with not only engineers but also with the public officials involved in the design of a significant federal building. The structure of the airport involved some innovative engineering. The enormous frame was constructed out of

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[528] *Dulles International Airport Terminal Building Fact Sheet, FAA News, undated, 1-8. Press information, box 497, folder 1367. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Portico to the Jet Age 1963, 80.*

[529] Dulles International Airport Master Plan Report *1964, 27.*

[530] Dulles International Airport Master Plan Report *1964, 27; Dulles International Airport Terminal Building Fact Sheet, FAA News, undated, 6. Press information, box 497, folder 1367. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[531] *Air Terminals for Jet Travel: Airport Development Planning 1961, 158-163;* Dulles International Airport Master Plan Report *1964; Our Two Largest Airports 1963, 90.*

[532] Eero Saarinen on His Work *1962, 96.*

light-colored reinforced concrete with a large dolomite limestone aggregate inclusion bush-hammered to achieve a large-grain marble-like texture. Because methods of mixing aggregates caused large sizes to segregate unevenly in the mix, the Saarinen office came up with an innovative method called gap grading, where the middle section of aggregate sizes were left out. Another innovation was based on the firm's continuous development work on sandwich panels in metal-to-metal laminate; a thin porcelainized aluminum sheet rolled to flatness and laminated ripplefree to a thicker undersheet for rigidity. This material in black matte finish was utilized in the control tower, because it could be curved without breaking.[533] The airport also featured modern service systems, such as apron fuel lines located underground with fueling hydrants at wing positions.

Construction of this unique structure was not a minor undertaking but Corbetta Construction Co carried it out successfully. The thirty-two massive concrete pylons were erected on concrete blocks measuring 36 feet long by 11 feet wide by 6 feet high. In order to build them, the reinforcing rods of the columns were assembled into steel cages on the ground, hoisted into place, and formwork built around them. One man had to stay inside the cage until the last minute and use a vibrator to prevent air pockets during the pouring of the pylons. To form the roof, pairs of cables ten feet apart were strung between the pylons on opposite sides of the building. They served initially to support the precast lightweight concrete panels comprising the roof. When the stiffening ribs were being cast in place, the proper curve of the roof was maintained with sandbags placed on the cables during the pours so as to stretch them to match the curve of the previously poured rib. Thus the construction process presented several unforeseen problems that were innovatively solved by the engineers on site (fig. 5.26).[534]

Financially the airport caused conflicts that resulted in prolonged processes of negotiations. The construction cost increased from the estimated \$50 million to \$175 million and was eventually covered with the fees paid by the airlines using the airport. However, airlines objected the radical and expensive lounges that would, in their view, substantially and unnecessarily increase the construction cost. Approving the mobile lounge concept in June 1958 CAA (Civilian Aviation Agency, the predecessor of FAA) expected that Saarinen would sell the idea to the carriers, but the first attempt in Washington on July 1, 1958 did not yield any results. Therefore Saarinen and the design team decided to visit each airline and illustrate the functionality of the mobile lounge concept with a movie. At first the office attempted to produce the movie itself: "We set a big site light above the whole terminal model. We had a whole crew of people with little tiny baggage carts and little tiny planes and all the machinery and paraphernalia that operated an airport. And we had to chart a path for it to function," recalls Norman Perttula, "In this choreographed scene, we would move an object to the prescribed spot. Dick [Knight] would take two or three photographs. Then we'd move to the next spot and he'd take two or three pictures, and so on. But every once in a while someone would forget to move their piece… when the film was finally put together, the erratic movement

[533] *Lessing 1960, 102.*

[534] *Dulles International Airport… Construction Triumph, Political Rhubarb 1962, 28; Lyttle 1963, 835-850.*

dominated. We convinced Eero that there were better ways to make a film. He got Charles Eames involved in that historic, classic illustration of how Dulles could operate."[535]

The soundtrack of the film lamented: "The grand total of walking done by passengers inside the ten major airports in 1958 would equal 100 trips across the country plus 20 walks around the world plus 4 ½ round trip treks to the moon."[536] By the spring of 1959, after having seen the *Expanding Airport* and hearing Saarinen's arguments, only Eastern, Northwest and Delta opposed the lounge, and E. R. Quasada, in the role of the newly formed FAA Administrator, authorized their development (fig. 5.27).[537] Saarinen had then managed the complex airport project in a manner of a "heterogeneous engineer;" he had, in his part, negotiated deliverables and convinced the FAA, the airlines and the federal decision makers that the daring airport concept was worth the cost.

The delayed airport project was finalized with the lead of Najeeb Halaby, whom President Kennedy appointed as head of FAA in January 1961. But even Halaby had to be convinced of the proposed design. "There was a meeting at the office on Connecticut Avenue to bring Halaby up to date on the airports design," recalls Gary Brown, who worked for Saarinen in 1956 and 1959-62, "I showed the Eames mobile lounge film from the balcony overlooking the two-story conference room… Eero made a presentation, with the model of the terminal building displayed across the far end of the room. When he was finished, Halaby said that, in his experience, although architects were good dealing with buildings' exteriors, they weren't good with the interiors. He went on then to describe his own ideas for Dulles, suggesting that the terminal be divided into sections, each one representing a different period of American history… Eero responded, and when he was through Halaby said 'I think that what you're trying to tell me is that I don't know what I'm talking about, and that I should stick to running the FAA and leave the design of the terminal building to you.' Much to his credit, he did. For me, this was a demonstration of Eero's formidable diplomatic skills and powers of persuasion, both important reasons – along with his better known design talent –for his success as an architect."[538] However, the FAA insisted in enlisting a group of artistic experts –including Mrs. George Y. Wheeler, Mrs. Aline Saarinen, Mrs. James H. Douglass, Mr. William Walton, Mr. Andrew Ritchie,

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[535] *Eames, Charles 1958.* The Expanding Airport. *Animated color film, 10". The cartoon film featured a soundtrack of the tramp-tramp sound of feet walking through the measureless tunnels of the sprawling airports. Charts explaining travel times and distances involved are found in Research, box 499, folder 1409. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library. Norman Perttula recollection*. Saarinen Swanson Reunion Proceedings *2001, 36.*

[536] *Eames 1958; Correspondence concerning Charles Eames film, box 462, folder 1304. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[537] *Other problems such as the delayed completion date, rising construction cost and internal FAA problems also complicated the construction process. Dulles International Airport… Construction Triumph, Political Rhubarb 1962; McQuade 1962, 97, 130.*

[538] *Gary Brown recollection.* Saarinen Swanson Reunion Proceedings 2001, 24-25.

Mr. Gordon Bunshaft, Mr. Henry Dreyfuss, and Mr. Harvey Wells –to make the terminal "not only functional but beautiful" along the chosen Americana theme.[539]

The problems of the airport continued even after Halaby's appointment. The prototype mobile lounge, which the Chrysler Corporation developed by May 1961, cost $1,6 million instead of the authorized $750,000, and the production of the lounges was going to cost another $240,000 apiece instead of the anticipated $100,000.[540] Furthermore, the prototype was not as elegant as expected. Norman Perttula describes it as a "huge out-of-scale vehicle [that] came lumbering along in the Chrysler yard. It was as big as some of the gigantic earth moving machines that you see in construction."[541] Airlines were in debt for ordering new jet fleets and therefore reluctant to support the soaring cost of the lounges. They continued to oppose the concept despite the fact that building a 20-gate finger system, their proposed alternative, would have cost an additional $3 million and had not met the future needs of an international airport of this magnitude. The airlines hired airport consultant Kenneth A. Osterberg to prepare a report that proved how the annual operation cost of the mobile lounge system would be higher than that of an equivalent finger system. Charles Landrum's counterargument, on behalf of the design team, was that Dulles was not a twenty-gate airport but rather a thirty-six gate international airport that would ultimately grow into sixty or ninety gates. "The larger the airport and the denser the traffic, the better and cheaper the mobile-lounge system becomes," he claimed.[542]

Halaby was able to get the carriers onboard with his diplomacy and persistence. He invited the airline presidents for a demonstration at Dulles airport and the lounge, which had been tested with mockups of various commercial aircraft, was driven through ice to meet FAA's Electra aircraft with the airline executives onboard. After the demonstration the carriers had to admit the concept was functional, but negotiations about the user rates were pending. In the end, Halaby signed a contract with Chrysler for twenty mobile lounges without the approval from the airlines. The agreement about the fees and rates was reached in May 1962, only six months prior to the opening of the airport.[543] When President John F. Kennedy finally dedicated the pioneering airport for jets on November 17, 1962, it was hailed for its monumental architectural expression and functionality. The airport embodied the technological future the United States was foreseeing in the height of the space race. It was to serve not only jets but also supersonic aircraft expected to enter

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[539] *Dulles International Airport fact Sheet, undated, 6. Press information, box 497, folder 1366. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[540] *Design for Jet Age 1962, 68; McQuade 1962.*

[541] *Norman Perttula recollection*. Saarinen Swanson Reunion Proceedings *2001, 36.*

[542] *Charles Landrum as quoted in McQuade 1962, 134.*

[543] *In November 1961, FAA awarded a $4,654,660 contract to Chrysler Corporation for 20 lounges ($232,733 each) for delivery of five units in October 1961, the tenth unit by November 1962; the fifteenth unit by January 1963; and the twentieth unit by March 1963. While Chrysler Corporation made the mobile lounge chassis, Budd Company designed and built its body. McQuade 1962, 136; FAA press release, May 2, 1962. Press information, box 497, folder 1367. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

service in the mid-1970s. The spirit of the airport was perhaps best encapsulated in the dedication program brochure's claim that aircraft at Dulles were taking 300,000 gallons of jet fuel and 20,000 gallons of aviation gasoline each day, which was an amount that would have "permitted 4.8 million miles of automobile travel, or the equivalent of 10 round trips to the moon."[544]

Saarinen's aim at Dulles was nothing less than to improve the entire concept of a modern airport. He never saw the Dulles International Airport completed, but the last time he visited the construction site on June 21, 1961 he claimed: "I think this airport is the best thing I have done. I think it is going to be really good. Maybe it will even explain what I believe about architecture."[545] Indeed, Dulles Airport is clearly an architectural statement but what does it actually communicate about Saarinen's architectural principles? To begin with, a close reading of the design process involved illustrates Saarinen's methodology: his scientific approach to the functional problem and the solution found through research; the expressive form reached through work on study models; the innovative structural solutions worked through with engineers and other specialist; and the overall design solution that combines function, expression and structure. Dulles exemplifies what Saarinen believed were the six principles of modern architecture. It is a modern masterpiece that asserts its presence over the landscape in a monumental and yet structural and simplistic manner. It evokes dignity and the sentiment of the future embodied in its technological and structural solution. It is a materially sound piece of architecture that manages to reorganize the modern airport and embody imaginaries associated with aviation. Hence, it is a brilliantly functional airport.

5.4. (Inter)national Modernity

If Dulles Airport is an example of how Saarinen negotiated technology, then Athens International Airport is a prime example of how he negotiated aesthetics in a project that could best be described as an essay in modernism. This project involved designing a new terminal building within an existing airport that was modernized in other respects by Ammann & Whitney. The Athens Hellenikon airport, comprising some 970 acres, was situated on the coastal plain between Mount Hymettos and the Saronic Gulf. The airport was in a need of immediate modernization, highlighted by the need to demolish several villas adjacent to the airport to allow President Dwight Eisenhower's Boeing 707 to land during his visit to Greece in 1959. The modernization project had a budget of $10 million, which included the runway, aprons, taxiways, navigation and communications equipment and the $3.6 million terminal building. The project was largely financed with an $8.2 million loan from the United States, which probably influenced the selection of an American engineering firm and architect. Ultimately the airport was to have forty-four

[544] *Dulles International Airport, Dedication Program, November 17-18, 1962. Press information, box 497, folder 1365. Series IV. Project Records, Job 5804: Dulles International Airport Terminal. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[545] Eero Saarinen on His Work *1962, 96.*

terminal gate positions. Another small terminal was to be built south of Saarinen's terminal to provide sixteen gate positions intended for domestic use, but these plans did not materialize and in the end Saarinen's East Terminal served international traffic, while Olympic Airways used the old West Terminal for domestic flights. Construction work began in 1962, but it seems that the military junta of Greece diverted funds and thus delayed the completion of the airport until 1969, five years after the expected completion date and eight years after Saarinen's death.[546]

Saarinen was commissioned to design the new terminal for Athens through Ammann & Whitney, who had prepared an analytical study for the development of the Athens Airport in 1959 and were, after having designed a new master plan, in the process of extending the main runway and upgrading the airport. Thus the continuous, rewarding and productive collaboration with Ammann & Whitney was the source of Saarinen's airport commissions and the success of his terminals was as much a result of Ammann & Whitney's groundbreaking structural engineering and expertise as it was the result of Saarinen's form giving and research based vision. In fact, Charles Whitney was a pioneering concrete specialist who, in the 1950s, had designed revolutionary thin shell hangars for American Airlines and TWA with architect Aymar Embury II. Thereafter Ammann & Whitney had become leading structural engineers responsible for many technological advances in airport construction.[547]

For the Athens Airport, the agreement for the architectural design of the terminal building was signed between Saarinen and Ammann & Whitney, who negotiated the details of the agreement between Saarinen and the Greek government. The Greek Minister of Communications and Public Works, Mr. Solon Ghikas, was adamant that Saarinen would start working on the project no later than a month from signing the contract, but Saarinen was very busy with other projects in the pipeline. In a letter to Saarinen, Werner Amman requested that Saarinen travel to Greece as he had received a cable from Ammann & Whitney's Athens office stating that "Gropius is in Athens ready take over" unless Saarinen finalized the negotiations in person. In response it was arranged that Saarinen would make a reconnaissance trip within three weeks after signing the contract, thus effectively starting the project in May 1960.[548]

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[546] *Athens Airport Being Expanded 1961, section V, p. 11; Merkel 2005, 213-216; Saarinen's Athens Airport a Classic Pavilion 1962, 51; Terminal Building for Athens Airport (Greece), undated. Presentation booklet by Ammann & Whitney, Engineers, Eero Saarinen & Associates, Architects for Terminal Building and Charles Landrum, Airport Consultant for Terminal Building. Reports, box 601, folder 1597. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library. Athens Airport was finalized by Saarinen's office staff with the lead of John Dinkeloo and Kevin Roche. It was one of the major projects the office was able to complete despite Saarinen's absence.*

[547] *Brodherson 1996, 83.*

[548] *Letter from Werner Ammann to Eero Saarinen, February 26, 1960. Correspondence and memoranda. Box 568, folder 1577. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

According to the agreement, Saarinen was to provide the architectural design and accompanying plans, perspectives, elevations, sections, models, details and information of building materials for the terminal building whereas working drawings and specifications were to be prepared by Ammann & Whitney, who were also assigned for field supervision, site inspection and all structural, mechanical and electrical engineering services. However, Saarinen was expected to personally travel to Greece for presentations of the preliminary and final architectural designs. The architect was also responsible for the services of Landrum & Brown, Airport Consultants and Bolt, Beranek & Newman, Inc, Acoustical Consultants (the former had worked on Dulles, the latter on TWA). It was further specified that Ammann & Whitney's engineer would be accommodated in the architect's office, while Saarinen would place his job captain architect in Ammann & Whitney's Athens office to supervise the preparation of working drawings and specifications.[549]

Saarinen's recent and extensive research on the typology and function of airports allowed him to concentrate on the aesthetic expression of the terminal building. Furthermore, he could rely on Ammann & Whitney's master plan and analysis of the local conditions. Yet, further studies were conducted on European airports.[550] The functional program of the airport was based on passenger volume projections up to the year 1968. These suggested that ten plane positions would handle ninety percent of the planes ninety percent of the time and that 37.9 percent of annual aircraft movements occurred during the peak season between July and October. It was clear, however, that the gradual transition from piston engine aircraft to large turbo-propeller and jet aircraft such as the Douglas DC-8, Vickers Viscount 900 Series, Vickers Vanguards, Convair 880, de Havilland Comet 4B, Boeing 707, and Lockheed Electra L 188, would significantly increase the current level of traffic at the airport.

Based on this volume of traffic, it was decided that a bus system transporting passengers to midfield islands would be unnecessary. Furthermore, even though these islands would have increased the capacity of the passenger handling facilities, the airport had other limitations. The site was restricted by nearby residential properties and natural obstructions to flight patterns, landings and takeoffs. Hence, the Athens project concentrated on improving the airport within the parameters set by the site. The existing runway was lengthened, a new taxiway and apron constructed, navigational aids (such as

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[549] *Preliminary design was to be presented within four months of the date of the contract and the final design four months after the approval of the preliminary design. Agreement between Ammann & Whitney, Consulting Engineers and Eero Saarinen and Associates for Architectural Services for Additions and Extensions to Athens Airport, Athens, Greece, May 1960. This contract was bound by provisions of another contract between the engineer and the Government of the Kingdom of Greece, dated April 6, 1960. Correspondence and memoranda. Box 568, folder 1577. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[550] *Research was conducted at Rome Fiumicino and Paris Orly in the summer of 1960. Landrum provided data of the airports in Stuttgart, Frankfurt, Munich, Copenhagen and Amsterdam. Area planning and research notes, box 568, folder 1572. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

ASR Air Surveillance Radar) installed, and Saarinen's international terminal constructed. Acknowledging that the airport would have growing traffic volumes, the terminal was also designed for lateral expansion from the central core with a minimum reorganization of the initial building. [551]

Intrigued by the context of his new terminal building, Saarinen wanted to place its design in dialogue with the setting of classical Greek architecture. "The challenge was complex," described Saarinen, "We had, of course, to design a building that would provide the best possible functional solution to air travel in Greece in the jet age. But beyond functional demands, there was the hope of making this terminal an appropriate and beautiful introduction to Greece, since it will give the visitor his first impression of the country. Finally, there was the challenge of creating a building which would belong proudly to the twentieth century, but would simultaneously respect the glorious tradition of Greek architecture."[552] Saarinen's preliminary sketches for the terminal, done with graphite on yellow tracing paper, show how he varied a classical colonnade and played with the rhythm of the façade until the load-bearing, post and lintel construction gradually took a modern shape: first, an outward leaning form of three cantilevered floors mirroring the gentle downward slope of the site and then, finally, a simplified row of columns supporting a low structure. The elegant design thus subsumed its initial inspiration into a modern structure vaguely reminiscent of post and lintel construction (fig. 5.28).[553] "Post and lintel construction is characteristic of ancient marble buildings of Greece," explained Saarinen, "This post and beam construction developed into long spans with daring cantilevers is natural to concrete and to our time. Built of concrete with pantellic marble aggregate, which becomes a very beautiful material, the building will have a shimmering white texture which looks so magnificent in the Greek landscape."[554]

The first scheme, presented to the Greeks in November 1960, was an expressionist volume soaring to the sky (fig. 5.29). But the negotiations with the Greeks were not easy and Saarinen's proposal was rejected. "The design for that building was a wonderful

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[551] *Terminal Building for Athens Airport (Greece), undated, 5-6. Reports, box 601, folder 1597. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Development of Athens Airport: Report, August 1959, 12-14, 26-32. Report by Ammann and Whitney, Engineers. Reports, box 571, folder 1595. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[552] *Eero Saarinen in a letter to Mr. Solon Ghikas, Minister of Communications and Public Works as quoted in Terminal Building for Athens Airport (Greece), undated, 1. Reports, box 601, folder 1597. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Saarinen's Athens Airport 1962, 51.*

[553] *Eero Saarinen and Associates, 1960. Athens Airport: conceptual elevation sketches. Eero Saarinen Collection DR2001:0004:001:001-DR2001:0004:001:010. Gift of David Graham Powrie. Canadian Centre for Architecture CCA Collection.*

[554] *Terminal Building for Athens Airport (Greece), 2. Reports, box 601, folder 1597. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

cascading concrete and glass building," describes Robert Ziegelman, who worked on Athens Airport and Dulles Airport projects between 1969 and 1961, "We took advantage of trying to deal with sun control, which in Athens would be a problem and tried not to use a great deal of glass and steel, which was popular in the buildings of late 50s and early 60s. There was a stairway leading from grade, into an area where you could look out over all the runways. Eero went to Athens to present it. Apparently, we missed the boat on what the client wanted because the design was totally rejected. When Eero returned from Athens, he walked up to Minos, a Greek who worked in the office, and said, 'Here you come from the cradle of western civilization and architecture and your people are no different than anybody in the rest of the world or in the United States.' Eero completely changed the parti after that. The original building we had created ceased to exist and a new model, with more glass and steel, was built instead."[555]

International Style modernism was what the Greeks wanted, not the extravagant late modernism Saarinen was developing in his laboratory. However, as always, Saarinen was attentive to the client's needs and delivered a design that evoked the imagery of international modernity while still incorporating his initial ideas. Hence, a more ordered volume replaced the dynamically outward sloping, multi-cantilevered profile. In the new design the structural system was clearly articulated, the passenger flow simplified, and the lighting of the vast terminal room improved with the curtain wall partitioned into five sections. Yet, the dominant form of the final design maintained something of the original counter-thrust upward, albeit in a less dramatic form.[556]

In the Athens project, Saarinen thus brokered between differing imageries of modernity. His regionally adjusted, climatically sensitive and site-specific modernism was rejected because, in the client's view, it was not associated with an affluent and modernized society. It portrayed the "wrong" kind of modernity. Instead, Athens Airport was to be a perfect and complete modern structure. It was to embody the modern ideal through the utilization of modern materials and technology. But as Marshall Berman reminds us, all monuments of modernity are bound to be obsolete as no mode of modernism is definitive. The Greek dream of modernity, embodied in the airport terminal, could then not possibly last as a sign of modernity and was, in fact, superseded by another airport in forty years.[557]

In the finalized scheme, presented to the client in May 1961, the principle façade faced the airfield (fig. 5.30). Deplaning passengers approached the building along landscaped terraces, which were sort of open-air fingers. These structures recalled Le Corbusier's notion of the "naked airport," where travelers would marvel at the grace of the airplanes as they walked along terraced walkways to a terminal building that would not diminish the scale of the aircraft. However, Saarinen's terminal building had grandeur. It rose over the airfield with a restaurant and office floor cantilevered over a low structure on the field

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[555] *Robert Ziegelman recollection.* Saarinen Swanson Reunion Proceedings *2001, 25.*

[556] *Terminal Building for Athens Airport (Greece), undated. Reports, box 601, folder 1597. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[557] *This ideal reflected the thoughts of Le Corbusier. Berman 1988 (1982), 7.*

side. The façade shimmered in white concrete made with Pentelic marble aggregate, and the entire building recalled classic Greek architecture despite its modern function. "We have tried to make the building, both in actuality and symbolically, the entrance gateway to Athens and to Greece," explained Saarinen, "Therefore, in contrast to many airports in which the high façade and monumental entrance face the city, this building faces the field. The majority of arriving visitors will approach it along beautifully landscaped terraces, instead of in enclosed fingers –an advantage due to the special, virtually rainless climate of Greece."[558]

On the landside the terminal was approached from a highway through a wide, tree-lined boulevard that provided views of the terminal against the magnificent panorama of the bay. It was a "dignified and appropriate approach," something that Saarinen had been struggling to create at Dulles. The building's mass comprised two boxlike forms that directly expressed the interior volumes. The lower section of the building was a large 240 feet long, 260 feet wide and 20 feet high rectangle that contained all functions concerned with passenger handling while the upper area was a 250 feet long, 120 feet wide and 10 feet high rectangle that extended over the main block in three directions. The cantilever was intended to cast a shadow over the windows below and protect them from the afternoon sun. The cruciform shaped columns penetrated the slab and their four-pronged capitals curled around to pick up hollow beams containing air-conditioning ducts. On the field side, these columns continued beyond the great slab and flowered out into capitals, reminiscent of propellers, to carry the upper, cantilevered volume of the building (fig. 5.31).[559] The structure was then a clever modern interpretation of classical architecture and it was these details that took Saarinen's design beyond any International Style modern

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[558] *Terminal Building for Athens Airport (Greece), undated, 1. Reports, box 601, folder 1597. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[559] *However, the construction process involved negotiations over technical details that would have compromised Saarinen's original design had the Saarinen office not insisted on certain features. For instance, air conditioning units required much larger duct sizes than originally anticipated, and the Greek construction code had specific requirements in the seismic environment. These threatened to separate the mechanical from the structural in the column design. The Greek also wanted to change the Athens-Vouliagmeni highway as the main access road, which would have compromised the views of the terminal on the approach road. Nevertheless, when the Saarinen representative in Athens, Gene Festa returned to the United States in July 1962, compromises had been reached on these topics. In addition, the Greek government laboratory had agreed to make test cylinders to approve the mix design for the concrete wall, and the government was ready to approve the drawings as the result of a mock-up study. Gene Festa in a letter to Kevin Roche, September 25, 1961; Roche in a letter to Festa, October 2, 1961; Roche in a letter to the Greek Ministry of Communications and Public Works; Festa in a letter to Roche, June 6, 1962. Correspondence and memoranda, box 571, folders 1579-1580; Terminal Building for Athens Airport (Greece), 2-6. Reports, box 601, folder 1597. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library; Saarinen's Athens Air Terminal 1962, 111-114.*

building. Like TWA and Dulles, this building evoked the imagery of flight, albeit in yet another form.

As the site of the terminal sloped toward the airfield, entrance was provided at the second floor level on the landside. From here viewers could continue to observation deck while passengers descended to the departures and arrivals floor (fig. 5.32). The fourth level housed restaurants and offices, while the third floor had a visitors' observation deck overlooking the airfield and the magnificent landscape. Airline offices and services were located in the basement. In the center of the landside façade, separating the arriving and departing passenger facilities, was a broad, monumental staircase, which led visitors to the observation deck. A second staircase led them from the deck to a public restaurant and bar on the fourth floor. Thus visitors were effectively separated from passengers, who entered on the second level and continued through check-in to a balcony overlooking the transit lounge. From there they descended to the lower level transit lounge with views over apron and airfield, shops, lunch and bar service, and seating for 400 people. Once a flight was called, passengers proceeded to the open terrace fingers, edged by pools and flowers and protected from blast by low walls, and walked to the aircraft parked on the apron. Transiting passengers, who constituted sixty percent of all arriving international passengers, were either taken directly to the transit lounge or took elevators to the transit restaurant and bar area within the upper, cantilevered section. Arriving passengers went through passport check and proceeded to the balcony on the second floor and from there to customs inspection and land transportation (fig. 5.33-5.37).[560] The building was an elegant and functional solution to the terminal building problem.

Unlike the TWA Terminal and Dulles Airport, Athens Airport did not enter the canon of modern architecture. This was probably because of its geographical location outside the centers of architectural debates and because it was only completed eight years after Saarinen's death. By then, Saarinen's architecture had been positioned in the history of modern architecture. He was no longer in the center of architectural debates and his buildings were surrounded by silence.

Saarinen's airport terminals were important in the typological development of the building type. Yet, they proposed very different solutions to the same design problem. The TWA Terminal at Idlewild involved the design of an expressive unit terminal serving a single airline within an airport city. Dulles International Airport was an innovative interpretation of a gate arrival terminal and its master plan addressed the design problem of an airport laid on tabula rasa. In Athens Saarinen designed a terminal building with open finger structures within a functional, albeit outdated airport. While Saarinen had studied the modern airport in detail and improved its functionality, it was the terminal building that gave the airports their architectural expression and identity. These landmark terminals served as gateways to their respective cities. They were the "architecture" of the airport, distinguishable from the "infrastructure" of the airport.

Saarinen's buildings included references to the typological development of the airport terminal. Thus the TWA Terminal expressed flight similarly to the Ramsgate Municipal

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[560] *Terminal Building for Athens Airport (Greece), undated, 3-4. Reports, box 601, folder 1597. Series IV. Project Records, Job 6005: Athens Airport. Eero Saarinen Collection (MS 593).*

Airport Terminal, and advertised the airline it served in the manner of Pan Am's International Air Terminal and Dinner Key Seaplane Base. Dulles International took the bus system employed at other gate arrival airports such as Amsterdam-Schiphol to another level of elegance and functionality. Based on thorough research it innovatively reorganized the modern airport, and reinterpreted federal architecture in the manner of the Washington-National Airport twenty years earlier. Athens International referred back to le Corbusier's "naked airport" concept, and redeveloped the idea of the primary façade facing the airfield. This had been experimented with at Washington-National and Sagebiel's Berlin-Tempelhof, where the innovative airside façade contrasted the classical landside façade.

Hence, to restate the question posed in the beginning of this chapter: what would be different had Saarinen not designed three airport terminals? Had he not done so, the airport terminal, perhaps, would have never entered the canon of modern architecture. More importantly, the airport terminal might not have received the architecturally bold and technologically innovative structural form Saarinen was able to award it through his research driven approach to architectural problems. These buildings were the result of Saarinen having negotiated technology and aesthetics in order to propose a new architecture. Saarinen's modern airport terminals thus resolved the contradictions of modern architecture and the airport terminal. In other words, his terminal buildings synthesized modern architecture and its antithesis, the modern airport terminal. Therefore they had to be noticed and –they had to enter the histories of modern architecture.

6. Conclusion

6.1. The Obsolete Airport Terminal

Eero Saarinen designed some of the most intriguing airport terminals of the twentieth century. As Vincent Scully argues, Saarinen understood "the American space, America's vacant space, and he understood the airport, which best serves it. Two of Eero's greatest designs clearly come out of that understanding of America's continental scale, TWA… and Dulles."[561] Especially Dulles International Airport has been praised as Saarinen's masterpiece. "Not only as a functional airport," claims Allan Temko, "but as a formal essay in concrete and as an expression of federal character, this new gateway to Washington could be recognized as the crowning achievement of his career." Saarinen's terminals were definitely progressive. Yet, according to Temko, "functionally and symbolically, Idlewild is already out-of-date, made obsolete, in truth, by Saarinen's own consummate masterpiece: the jet-age international airport for Washington."[562] In Temko's view (echoing Reyner Banhams's observation),[563] the TWA Terminal was thus already obsolete by the time of its completion. Joe Lacy enforces this interpretation by stating that the TWA Terminal "is more a piece of sculpture than it is a good airport terminal. Dulles is just the opposite. I'm amazed that it just hasn't had a bigger influence on the design of air terminals."[564]

One reason why Dulles International has not been more influential is that airports are part of a constantly transforming transportation infrastructure. Even the most innovative technical solution may soon become dysfunctional, or, as in the case of the mobile lounge, too expensive to maintain and reproduce. In fact, airport terminals are demolished more often than modernized. They are easily expendable because aeronautical innovations and economic and structural changes in the industry surpass them. Many airports are also located in areas where demands for urban redevelopment are accumulating. Nevertheless, airport terminal is one of the most emblematic building types of the 20th century and, as Thomas Mellins argues, many terminals built between the thirties and the sixties "are among our finest exemplars of mid-20th-century Modernism, executed by some of that style's most gifted interpreters."[565] Indeed, airport terminals have architectural value and therefore their preservation has become a major concern (and a matter of severe disputes).[566] Even when Saarinen intended his terminals as permanent, albeit extendable structures, they have not been spared from alterations, preservation disputes, and partial demolition. Currently, the TWA Terminal is preserved as a relic of aviation within an

[561] *Scully 2006, 24.*

[562] *Temko 1962, 10, 48, 116.*

[563] *Banham 1962b.*

[564] *Joseph N. Lacy with John Gerard, September 15, 1981, 13. Collection of Oral History Interviews, No. 240. Cranbrook Archives.*

[565] *Mellins 2005.*

[566] *Such dispute is ongoing, for instance, over the future of Helsinki-Malmi Airport.*

active airport while Athens Airport was closed down in 2001. Only Dulles Airport remains operational, although it too has undergone several alterations.

One of America's greatest transportation landmarks –Pennsylvania Station by McKim, Mead and White –was demolished the same year when the TWA Terminal was dedicated. Perhaps this was symptomatic, as it took only forty years until the TWA Terminal was likewise found unfit for modern transportation.[567] By then, the sculptural form of the TWA Terminal had been obscured by additional structures such as baggage handling conveyers, vestibules, signage, and a canopy for ground transportation. The interior was cluttered with metal detectors and x-ray machines, a ramp over the original staircase, and a new ticketing area atop the former lounge.[568] The unity of its design had not adjusted well to the demands imposed by jumbo-jets, airline deregulation, and the threat of terrorism, despite TWA President Tillinghast's vision that the terminal was designed for the era of supersonic aircraft (when a coast-to-coast flight across the United States would take only 90 minutes).[569]

Fortunately the TWA Terminal has been protected as a landmark since 1994. When American Airlines purchased TWA and announced it would vacate the terminal in 2001, architects and preservationists (including Philip Johnson, Robert A. M. Stern and the Municipal Art Society of New York) first, prevented its demolition and then, objected to the plan to transform the terminal into a restaurant and convention center surrounded by a new, 1.5-million-square-foot terminal.[570] However, a new JetBlue Terminal, designed by Gensler, was constructed on the apron behind the terminal, and opened for operations in 2008. As it was envisioned that Saarinen's building would serve as a ticketing lounge for the new terminal, its satellites were demolished.[571] The tubular passenger bridges now lead to the JetBlue Terminal, although Saarinen's building has remained closed since TWA ceased operations in October 2001. Several plans have been made to utilize it as an aviation museum, convention center, hotel or a first class lounge, but the cost of renovating the building is prohibitive. According to a JetBlue executive, Saarinen's building would not meet the requirements for contemporary aviation as "there is no room for curbside check-in, no way to move baggage efficiently through the building and no place to put security equipment like bulky explosive-detecting devices. And the gently

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[567] *MacRorie 1962, 53-55; Mellins 2005, 130.*

[568] *The roadway-island cover, which is 330 feet long and 22 feet wide, was designed by Witthoefft & Rudolph Architects. Addition to TWA Flight Center 1978; Fisher 1992, 96.*

[569] *Senators Will Speak for Dedication of TWA's New Trans World Flight Center, 1962. Press release 051562. Press materials, box 330, folder 932. Series IV. Project Records, Job 5603: Trans World Flight Center. Eero Saarinen Collection (MS 593). Manuscripts and Archives, Yale University Library.*

[570] *Beyer Blinder Belle planned the restaurant and convention center renovation, William Nicholas Bodouva the new terminal building for JetBlue and United Airlines. In 2005 the terminal was nominated as one of the buildings on the National Trust for Historic Preservation's list of 11 Most Endangered Places in America. Stephens 2001, 63-66.*

[571] *Unlike Saarinen's satellite the later satellite building by Kevin Roche John Dinkeloo & Associates (1970) did not enjoy a landmark status.*

arched tubular bridges do not meet modern requirements for people with disabilities."[572] The most recent, 2014 plan by Andre Balasz' Standard hotel chain, is to transform the terminal into a luxury hotel, conference center, restaurant and spa, but funding for this plan is still pending. Hence, the TWA Terminal has become a relic of aviation surrounded by an operational airport.

Athens International Hellenikon Airport is nowadays a similar relic of aviation. The airport was closed down in 2001 and replaced by Eleftherios Venizelos International Airport, which lies just twenty miles east in the hills of Spata. The plan to convert the Hellenikon Airport into an Olympic village did not materialize, but the old domestic carrier terminal was remodeled to house activities for the 2004 Games, and the northwest portion of the airfield was redeveloped into a sports park with venues for Olympic canoe and kayak slalom, field hockey, baseball and softball. One of the hangars was converted into a fencing venue and indoor basketball arena. Nowadays the former West Terminal hosts the Olympic Airways Museum with some aircraft parked on the apron. Saarinen's terminal was envisioned to serve as an exhibition and conference center, but these plans were not materialized. In 2005 architects David Serero, Elena Fernandez and landscape architect Philippe Coignet won an international competition arranged for the design of a Metropolitan Park in Hellinikon, but the Greek government did not proceed with the implementation of the proposal. Finally, in 2011, Hellinikon S.A. was founded to attract investments and redevelop the site of the airport and the vicinity into a mixed-use landmark location. At present, plans for the park have been indefinitely postponed amidst the financial crisis. Saarinen's building is deteriorating, and its future remains uncertain.[573]

In contrast, Dulles International is an operational airport. It was recognized as Saarinen's greatest architectural achievement immediately after its completion. The American Institute of Architects posthumously awarded Saarinen its Gold Medal Award in 1962, and the AIA included Dulles on its 1976 list of the 50 most significant American structures built since the revolution. In 1978 Dulles was one of the very few buildings to be placed in the National Register of Historic Places without having reached the 50 years minimum age usually required for eligibility. In 1989 the Dulles Airport National Register Historic District was designated, and it includes the main terminal and control tower, the twelve original service buildings, the original mobile lounge fleet, the parking bowl, access roads and the original landscape features.[574]

Over its 50 years of operation Dulles has undergone several modifications to accommodate the growing volume of travelers and meet the demands imposed by rapid technological change and heightened security measures. The original plinth, access roads and base of Saarinen's initial design were constructed to accommodate the extension of the main terminal to the envisioned 1,200 feet, but this apparently simple extension plan

[572] *Dunlap 2003.*

[573] *Hellinikon S.A. marketing material for investors, Ellinikon International Airport, http://en.wikipedia.org/wiki/Ellinikon_International_Airport. Retrieved, October 31, 2013; Hellinikon Metropolitan Park, http://en.wikipedia.org/wiki/Hellenikon_Metropolitan_Park. Retrieved, October 31, 2013.*

[574] *Ward undated, 16.*

involved complicated engineering, design, construction and preservation challenges and was not carried out until the 1990s.[575] Several lesser modifications and temporary constructions were therefore executed before the extension of the main terminal. In 1980, in order to increase the waiting area, Hellmuth, Obata and Kassabaum (HOK) added a low, sky-lighted corridor on the field side of the building. It pushed the boarding gates 50 feet toward the apron through "a pair of low sheds appended to the south façade and separated from each other by the connector to the control tower." This expansion aimed to meet the needs of the jumbo-jets carrying up to 300 passengers. The original mobile lounges simply could not transport the passengers of such big planes in a single run, but had to make several trips between the plane and the terminal. Therefore the original fleet was supplemented by twelve lounges of a modified design and larger capacity. Baggage handling facilities were likewise enlarged, taking advantage of the basement underneath the expanded departure lounges.[576] Later, air safety concerns resulted in the closing of the mobile-lounge doors that plugged into the airside bays between the columns in favor of a single entrance with a narrow x-ray screening point. In the light of these expansion needs, HOK with Peat, Marwick, Mitchell, and Burns & McDonnell revised the master plan in 1985 and recommended the construction of a new midfield concourse and the expansion of the main terminal according to the original design.[577]

In 1989 the New York office of Skidmore, Owings & Merrill (SOM) added an International Arrivals Building, which rose only to the height of the plinth but continued 300 feet west of the terminal. This structure served as the base for another expansion, which in 1997 extended the terminal by 320 feet at each end and doubled its total size to 1,249 feet. This extension was realized by SOM in collaboration with Ammann & Whitney. It added new space for baggage handling and arrivals, anticipated a future underground rail connection to existing and planned midfield terminals, and reprogrammed the terminal space. The extensions of the terminal replicated the distinctive concrete structure. New parts of the terminal building had the same concrete finish, window profiles and terrazzo floors as the original terminal, but glazing replaced mobile-lounge portals and the low ticketing and concessions structure was shifted in stages 20 feet closer to the airside to allow more queuing space for ticketing. However, the ticketing counters have the same custom typeface for signage, luminous ceiling and rosewood paneling as the old counters. SOM's renovation thus alleviated congestion and re-created the grand open space that had over the years become obscured.[578]

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[575] *Extension meant that, for instance, historic fabric such as original walls and vehicle ramps had to be removed and the experience of moving from ticketing to planes altered to meet security requirements. Replicating engineering techniques of the 1950s was by no means uncomplicated. Furthermore, the extension involved several decisions such as preserving the damaged and discolored original polished concrete floor that helped to clarify the division between the original and new structures. An inventory of the original building was carried out to guide preservation decisions. Ward undated, 16-17.*

[576] *Freeman 1980, 46-51; Greer 1988, 38, 43.*

[577] *Dulles Airport Expansion, Washington D.C., Skidmore, Owings & Merrill 1993, 40-41.*

[578] *Freeman 1997, 62-67.*

The renovation was necessary because the original airport was designed to accommodate eight million annual passengers, but the annual number of travelers had by then reached 11 million.[579] Eero Saarinen had the foresight to stretch out the circuit road, terrace the plinth and punch blank portals into it, but the narrow arrival and departure roads and attendant curbside areas were not adequate for contemporary mass air travel. Therefore SOM widened the roads and managed to increase the number of portals in the plinth from eight to fourteen by spacing them closer to each other while replicating Saarinen's design. In addition, SOM reconfigured the lower-level baggage claim routing delivery devices around the existing structure and excavated basements under the additions to expand and automate baggage handling.[580] New parking garages were also located to the north and west of the existing historic parking lot and the perceived height of these structures purposely reduced by placing lower levels below grade. Furthermore, the site treatment included landscaping that was consistent with Kiley's original plan. When the Dulles Development program (called d2) was launched in 1998, it included three permanent tiers of midfield concourses to provide more aircraft gates and an underground, automated people mover system to link the concourses with the main terminal. These low horizontal structures with expansive areas of glass replaced several temporary structures and unified the aesthetic appearance of the midfield concourses.[581] The latest modernization project will add an underground train to connect the main terminal with the midfield concourses.

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[579] *At first, air carriers favored National over Dulles. Dulles was planned for heavy, long-distance, four-engine type jet aircraft such as Boeing 707, Boeing 720 and DC-8, which could not use National's short runways. However, already in 1964 the three-engine, medium-range Boeing 727 went into operation and it was able to use runways even shorter than National's 6,800-foot runway. By 1965 National was handling seven million passengers in propeller planes since Halaby would not allow jets on National in an attempt to build up traffic at Dulles and curb jet noise over the city. Halaby's successor William F. McKee opened up National for two- and three-engine jets in April 1966. Thus, National served short- and medium-range flights while Dulles handled only long-distance international operations. In 1979 National handled 15 million passengers compared to 3.4 million at Dulles. National was a 10-minute taxi drive away from the White House and serviced by Washington Metro while Dulles was 40 minutes from downtown without a metro connection. Airline Deregulation Act of 1979 further decreased the operations at Dulles as airlines pulled out of airports offering low load factors. The declining economy, high fuel and operating costs did not help and in 1980 Dulles had only 2.6 million annual passengers. In 1981 the Metropolitan Washington Airports Policy came into effect setting the annual maximum passenger volume at National to 16 million and limiting the flying range of jets using it, establishing a nighttime curfew for large jets, and reducing hourly slots for large jets from 40 to 37 during National's operating hours 7am-10.30pm. Landing fees and mobile lounge charges were waived for air carriers at Dulles and regional and commuter airlines were permitted to use the base of the control tower for boarding in order to make a quick turnaround. Bus service to Washington was also improved and the access road extended in order for Dulles to grow. Freeman 1980, 48; Milner 1982, 15.*

[580] *Freeman 1997.*

[581] *Ward undated, 18-19.*

New structures and alterations meeting the demands of increased capacity have left the distinctive features of the landmark terminal largely intact and have therefore not raised many objections. Skidmore, Owings and Merrill's work was even praised for subordinating the new designs to the original vision of Eero Saarinen.[582] One of the few critics was Peter Blake, who in 1988 objected the "poor, stripped-down version of the original Mobile Lounge" purchased to enlarge the mobile lounge fleet, the insensitive design of security checks, the departure lounges that blocked access to departure gates, the temporary apron buildings, and the plans to build a large open parking garage. He claimed: "Dulles represents a giant step in airport planning, a giant step in long-span buildings, and a giant step in the area of urban buildings. No one, in this century, has designed so splendid an aerial gateway, anywhere."[583]

What should then be preserved when it is proposed that a terminal building is a landmark? Landmark terminals may easily become isolated relics of aviation in the manner of the TWA Terminal and Saarinen's terminal building in Athens. The alternative is to continuously update the terminal (in the manner of Dulles International) to meet the demands of contemporary aviation. Another alternative is to convert terminals to serve other functions. For instance, the International Air Terminal and Dinner Key Seaplane Base now serves as the Miami City Hall, but in its current state it is almost impossible to imagine this building as a functional terminal. Other terminals have become aviation museums, which is likely the most suitable use for an outdated terminal. At least Le Bourget still serves a function related to aviation and visitors may imagine how it was at the days of its grandeur. It then seems that continued use is the only way to preserve a terminal, since has not a terminal building, that no longer serves as an integral part of a functional airport, ceased to be a terminal? While discussion has often focused on the passenger terminal, it is only a fraction of the airport that hosts a variety of buildings such as hangars, service facilities, warehouses, cargo and air terminals, control towers, utility plants, garages, and hotels.[584] Even though the airport's uniqueness seems to culminate in its terminal building, the airport would not be complete, nor the terminal functional without them. Therefore utilitarian buildings are also in need of tighter regulation and preservation in order to maintain the integrity of an architecturally noteworthy airport. The issues involved in the reuse and preservation of the airports notwithstanding, it is paramount to save some of the obsolete terminals or we risk loosing the history of this building type before its specificity has been fully acknowledged. One of the key contributions of this study is, therefore, to merit serious attention to the airport terminal as an emblematic building type of the twentieth century.

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[582] *Freeman 1997; Merkel 2005, 227.*

[583] *Blake 1988, 300-301.*

[584] *In the Dulles master plan, the terminal area includes areas reserved for related services such as air mail, cargo, maintenance, general aviation, telephone exchange and weather bureau, and facilities such as fire and crash stations, office buildings, utility plants, concessionaire facilities, parking, hangars and apron. This area is complemented with commercial facilities zone, greenbelt, vehicular zone, and industrial area. Airport Development Planning: Air Terminals 1961, 158-163; Dulles International Airport Master Plan Report 1964.*

6.2. Nodes in the Novel Networks of Modernity

Even if no longer used as terminals, Saarinen's buildings stand as statements about a new architecture he was producing in his laboratory. They help to clarify Saarinen's position in the historiography of architecture and explain why the airport as a building type did not penetrate the histories earlier. In the light of these three terminals, it is clear that Saarinen did not have a distinct style, but his approach to architectural problem solving was comprehensive. Saarinen's office was a laboratory for building problems, innovative materials, structures and technologies, novel working methods and a refined modern vocabulary. Saarinen analyzed the airport design problem, observed operational airports, and utilized scale modeling as a scientific tool to produce structurally and aesthetically innovative airport terminals. Hence his working methods were similar to those of a scientific laboratory that yields results based on experimental fieldwork. According to Latour, such a laboratory works in three phases: first the laboratory is moved to the place where the phenomenon to be translated is found; second the phenomenon thus transformed is transported into a safe place where certainty is increased because the environment may be dominated; and third the initial conditions are transformed in such a way that the work carried out during the second stage will be applicable.[585] Saarinen's teams on airports similarly observed the phenomena related to aviation, studied the collected data in their design laboratory, experimented with the form and the organizational principles of the airport terminal, and finally transformed the conditions of the airport to match the findings of the second stage. In other words they constructed functionally and aesthetically transformed airport terminals to accommodate the newly defined organizational needs.

This laboratory-like working methodology meant that results from research and experiments were inscribed in homogeneous terms that could be accumulated, archived and compared to produce credible argumentation (and client presentations). But according to Peter Galison, there is no such thing as a transtemporal or transcultural laboratory.[586] Rather, the laboratory has a history that ranges from the alchemist's room to a contemporary research laboratory and other spaces of experimentation, such as the architectural office. In these spaces similar processes of experimentation, hypothesizing, testing and proving take place and are documented. The field theater of proof, in architecture's case the building, is then utilized to visualize the findings and gain undisputable results.

In the case of Saarinen's airports, the architect's diagrams showed the results of his research, but it was only his airport buildings that made his theories and findings visible. They reorganized the airport functionally and gave it a technologically innovative and aesthetically expressive form. The mobile lounge concept reinterpreted the emerging bus system and awarded it with futuristic imagery of the space age. It took the centralized gate arrival terminal to a different level of functionality and aesthetics. In the TWA Terminal the satellite terminal received an imaginative form that served the publicity needs of the

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[585] *Latour 1988 (1984), 75.*

[586] *Galison 1999, 1.*

airline and made it a unique landmark among the (often International Style) modern terminals at New York International Airport. On its part, Athens, with its primary façade facing the airfield, became a landmark entrance point to the city and reinterpreted the open finger terminal concept. As demonstrated by these buildings, the airport terminal had by the sixties thus become a modern transportation hub and an entrance point to the metropolis it served. It was an essential part of the techno-environment initiated by the aircraft that had punctured the flow of history in the same manner as Latour describes the emergence of the computer and the atomic bomb.[587] And it was the architect's task to give this techno-environment visual form.

Postwar modernisms, exemplified by Saarinen's terminal buildings, were produced in the architects' studios, historians' laboratories, and organizations such as CIAM that were geographically spreading the networks of architectural knowledge. It should therefore be asked in which particular studio, on which table, and with whose input was a connection in the network established? According to Latour, prior framing, panoramas, and master narratives discipline us to think that interactions occur in a wider context or *Zeitgeis*t. By contrast, the topography of the Actor Network Theory allows only a narrow view of a flattened landscape, and exposes a connected whole. It reveals the fragility of connections and lack of control over what is left between the networks.[588] Writing a "thick description" of a specific design process, such as the one in the Saarinen office, is this kind of research that aims to study connections, local sites and events in contrast to explaining with structures, *Zeitgeist* or context. Saarinen's laboratory and his airport terminals are local sites that cannot simply be placed within a wider context of modernism. Architectural modernism is rather a panorama that should be added like everything else into the multiplicity of sites to deploy. Hence, I argue that modernisms were *factually* mediated and materialized inside Saarinen's laboratory and in the airport terminals he designed. Keeping this in mind, it would be relevant to map other architectural offices as similar laboratories and establish them as nodes in the networks of expanding architectural modernisms.

Saarinen's airport terminals were architectural statements aiming to revise the modernist idiom. But a new architectural language can only be adopted if it is made equivalent to everything in the previous one. That is to say that interwar modernists had to replace each element composing the definition of architecture in the preceding styles with a new term, if they wanted to convince others of their claim for a "new tradition." New actors involved in the processes of modernization had to be employed to explain every main attribute of the previous architectural language. In this manner modern architecture replaced preceding styles with a new architectural vocabulary.[589] Airport terminal as an emergent building type could not serve this purpose and therefore it was excluded from the discourses of modern architecture (albeit arguably it could have been employed as an

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[587] *According to Latour the flow of history is punctured with radical breaks and emergence of nonhumans like laws of gravity, the atomic bomb, and the computer. Latour 1993 (1991), 69-71.*

[588] *Latour 2005, 181-189.*

[589] *See the reading of pasteurians, who similarly replaced anthrax with anthrax bacillus in Latour 1988 (1984), 78.*

example of a modern building that would require a totally new vocabulary to express its function). Second-generation modernists, such as Saarinen, were similarly aiming to revise the modernist idiom, and for them the airport terminal presented a design problem through which architecture's relation to technology could be revised. It is in this vein that Saarinen and his contemporaries' "eclectic" or "proto-postmodern" architecture, and Saarinen's terminal buildings specifically, should be read as knowledge claims promoting a renewed architectural vocabulary: a new architecture.

If Saarinen is repeatedly seen as a late modernist or proto-postmodernist, a hybrid of sorts, so too his airport terminals are hybrids that challenge the structure of classification inherent in the historiography of modern architecture. It is not sufficient to conclude that the late fifties and the early sixties were an era of late mannerist modernism or a transition period to postmodernism. Rather it was a period that witnessed the proliferation of architectural modernisms outside the dominant, techno-deterministically determined International Style modernism. Seen through hybrids like Saarinen's airport terminals some ideas in the historiography are necessarily replaced. It is not satisfactory to study the architect as a sole innovator. Neither is it convincing to argue that modern architecture would follow the parallel development of technology and that every new technology or material would require a new architectural vocabulary. Most importantly, it cannot be claimed that the typology of a building type would form a natural trajectory of development and not be influenced by independent actors, who succeed in advancing certain organizational principles, aesthetics and aviation technologies while others decline. Postwar architects labored in networks mediating modernity and made individual decisions about how to relate to technological developments or utilize emergent technologies in their design practice. Hence, the particular architectural phenomena "Saarinen" and "airport terminal" destabilize the historiography. The reason for this is that Saarinen's airport terminals are simultaneously architectural and technological artifacts, nodes in the social networks constructing the community of modernists and travelers, and architectural statements revising the modernist idiom.

The exclusion of the airport terminal from the histories of modern architecture was contingent upon the definitions of modernity and technology inherent in the writing of architectural history, and the resulting myopia in the classification of emergent building types. When these definitions are altered, the airport terminal appears as a uniquely modern building type amidst the processes of modernization and technological developments. This requires that the idea of modernity as positive and harmonious progress (the programmatic concept of modernity) is complimented with the notion of transient modernity mediated by buildings outside the canon. Furthermore, if we understand that architecture and technology are similar cultural artifacts shaped by the contingencies of their historic and social production, then the airport terminal appears as an emergent building type with a specific (and not simply causal) relationship to one of the seminal technologies of the twentieth century, the aircraft.

The typological instability of the airport terminal as an emergent building type was related to the negotiations about its dual function as infrastructure for aviation and landmark architecture for a community. It was a node not only in the expanding networks of air routes, but also in the networks of architectural practices and discourses, technologies, and various actors partaking in their production. The airport terminal developed –along the institutionalization of modern architecture –from the early aerodromes and airfields of the twenties to a recognizable building type in the thirties. Airports were frequently rebuilt to meet the changing demands of aviation and while some early air stations were functionalist, others represented stylistic and regional variants of modern architecture such as Art Deco, streamlined modern, Italian rationalism and Scandinavian modernism. After the Second World War the so-called "three generations" of airports were followed by the "fourth, fifth and sixth generations." Criticizing the idea of generations, I have suggested that postwar airports be instead classified by their organizational characteristics as the centralized and decentralized airport type, and further, as the gate arrival, finger, and satellite terminal. Instead of following a predetermined development pattern, the terminal building was shaped by techno-social processes enforcing certain formal and technical solutions while others stagnated. The visibility of these alternative development patterns questions the development trajectory of techno-deterministically defined modernism and reveals alternative modernist discourses and technological possibilities that were present when modern architecture was institutionalized. It is in this sense, following these alternative development patterns, that I claim the dominant, techno-deterministically defined International Style modernism could be "uninvented."

Postwar architects, like Saarinen, were exploring the stylistic and organizational parameters of the emergent airport terminal building type. Through the specific case of the airport terminal, Saarinen was negotiating technology and modern aesthetics in the manner of other modernists, who had identified a newfound synthesis in the "new tradition" or "machine age." But what differentiated Saarinen's synthesis from such machine aesthetics was that his airport terminals were not simply aestheticizing "the machine," but were actually operating as (admittedly aesthetic) machines, transferring people from ground transportation to the aircraft and the air routes connecting the terminal location to other nodes in the networks of aviation. What is more, Saarinen was striving to integrate new technologies into the architectural artifact. One such case was the Bell Labs and its mirrored glass façade, which integrated the reflective metal sheeting technology (developed for space aircraft) into the architectural artifact. Another such case is the mobile lounge, which was –essentially –a new technological artifact envisioned by an architect and realized by engineers. This vehicle was a constituent element in the organization of the new jet airport and brought technology into the very center of architecture as a subsystem of a larger technological system. Like other technological objects the mobile lounge had its materiality, structure, and performance but also social, economic and historic qualities. It was a technological artifact that merged with the architectural artifact. Therefore, it was not only Saarinen's position in the field of architectural practitioners but also his engagement with technology and his laboratory-like working methods that made the inclusion of his terminals in the history of modern architecture possible. Saarinen's modern terminals reconciled the contradictions between modern architecture and its blind spot, the airport terminal. This allowed the historians to notice the emergent building type and include it in the narrative of modern architecture.

Saarinen's airport terminals and their position in the history of modern architecture have in this study been analyzed with the methodologies of Science and Technology Studies (STS). These methodologies enabled me to examine architecture in relation to technology, uninvent techno-deterministically defined modernism, define the airport as a large technological system, analyze its subsystems such as the mobile lounge, and view the role of nonhuman *actants* such as the aircraft in the development of a building type. The ideas of the laboratory and the "heterogeneous engineer" along a modified version of the Actor Network Theory (ANT) allowed me to describe Saarinen's architectural office as a laboratory for a new architecture. Thus I have created as "thick" a description of the airport projects as is possible based on the fragmented historical documentation. However, this study has also exposed the limitations of the STS methodologies when applied to the writing of architectural history. While STS aids historians in noticing and writing the history of socially, economically and politically engineered development trajectories, the translatability of the STS methodologies into the study of architecture is not uncomplicated. That is to say that while it is important to acknowledge the role technological objects play as *actants*, there is a limit to how many of them may be described without loosing the integrity of the historical narrative; it only makes sense to describe nonhuman actors to the extent this serves the purpose of explaining an interesting historical phenomenon. Furthermore, while STS methodologies may be used to describe negotiations over the definitions of architecture, these models do not quite capture aesthetics, which is what differentiates architectural design from techno-science. Hence, while STS provides many exciting ideas for the study of architectural history, it needs to be balanced with the methodologies of history writing.

With these conclusions this study has reached the point when the pieces of the puzzle seem to fall into place. As Carlo Ginzburg and Adriano Prosperi state it: "There comes a moment (though not always) in research when all the pieces begin to fall into place, as in a jig-saw puzzle. But unlike the jig-saw puzzle, where all the pieces are near at hand and only one figure can be assembled (and thus the correctness of each move be determined immediately), in research only some of the pieces are available, and theoretically more than one figure can be made from them."[590] The pieces out of which this narrative was assembled are fragments forming a figure that is as comprehensive as may be expected when made out of the necessarily incomplete evidence. Among other narratives concerning Eero Saarinen and the airport terminal, this porous narrative, in its part, contributes to our understanding of the historiography of modern architecture, its logic of inclusion and exclusion, and our acknowledgment of the airport terminal as an emblematic building type of the twentieth century.

Examining the airport terminal in relation to modernity and technology, I have shown that science, technology and architecture are similar cultural products within larger cultural patterns, and confronted the techno-deterministic idea of their parallel development trajectories. I have outlined the history of the airport terminal and shown that

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[590] *Carlo Ginzburg and Adriano Prosperi as quoted in Tafuri 1987 (1980), 1. Originally published as Ginzburg, Carlo & Prosperi, Adriano, 1975.* Giochi di pazienza: Un seminario sul "Beneficio di Cristo". *Turin: Einuadi, 84.*

its history could have been written within the usual definition of modern architecture. Therefore, while some terminals easily fit in the narrative of modern architecture, I have suggested to uninvent techno-deterministically defined modernism in order to include terminals representing variants of architectural modernism.

Furthermore, I have shown that Saarinen's office was one of the postwar laboratories for a new architecture. In his office formal and technical innovations were transferred from one scale model to another, and one building type to another, validating Saarinen's claim that a new architecture was indeed "well under way in the research laboratories"[591] of the architects and, I would add, historians of architectural modernisms. Modern architecture and its antithesis, the airport terminal, were synthesized in Saarinen's architectural laboratory. This synthesis allowed the terminal building to transcend its utilitarian-technological nature as transportation infrastructure and led to its inclusion in the history of modern architecture as an emergent modern building type that has its own history and parameters for design. The airport terminal is a specific node in the networks of technology and modernity. According to Eero Saarinen:

> "An airport should be an expression related to flight. It should make one feel the excitement of arrival and departure and the pleasures of adventures of travel."[592]

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[591] *Saarinen 1953a, 7.*

[592] *Saarinen 1957, 49.*

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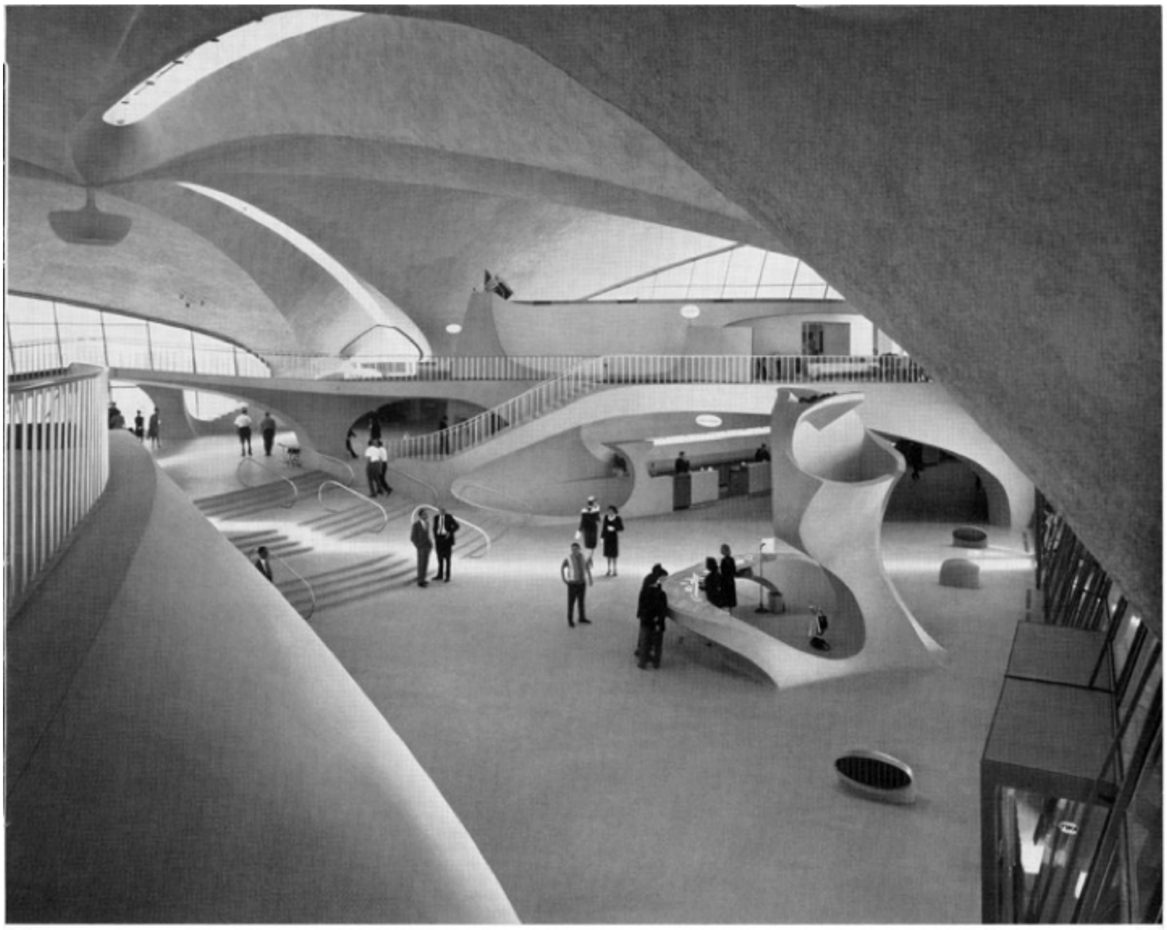
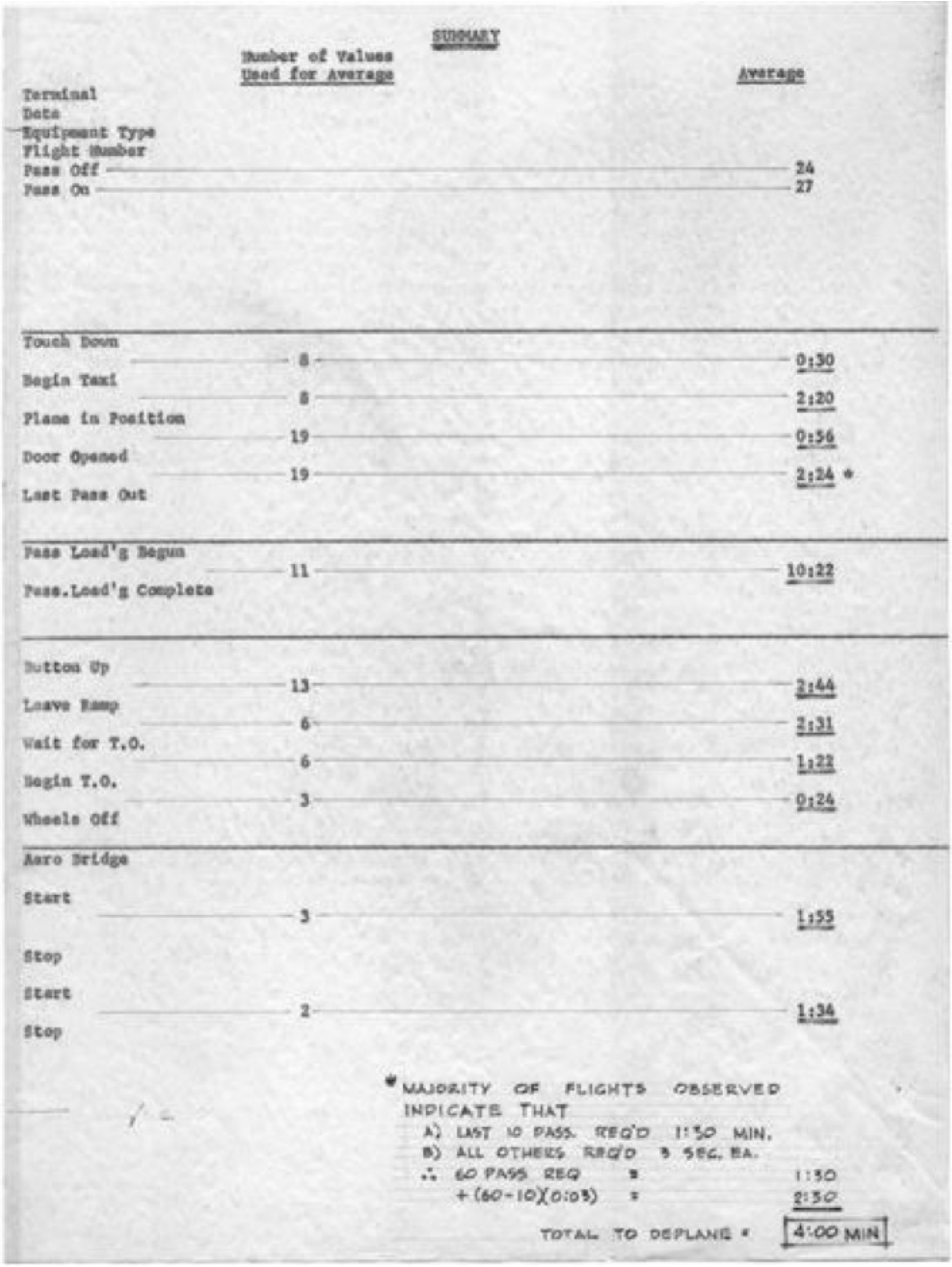
Figures

1.1. Eero Saarinen: Trans World Airlines Terminal, New York, NY, 1956-62, in 2007, photo: Susanna Santala



1.2. Trans World Airlines Terminal, New York, NY, interior in the 1960s

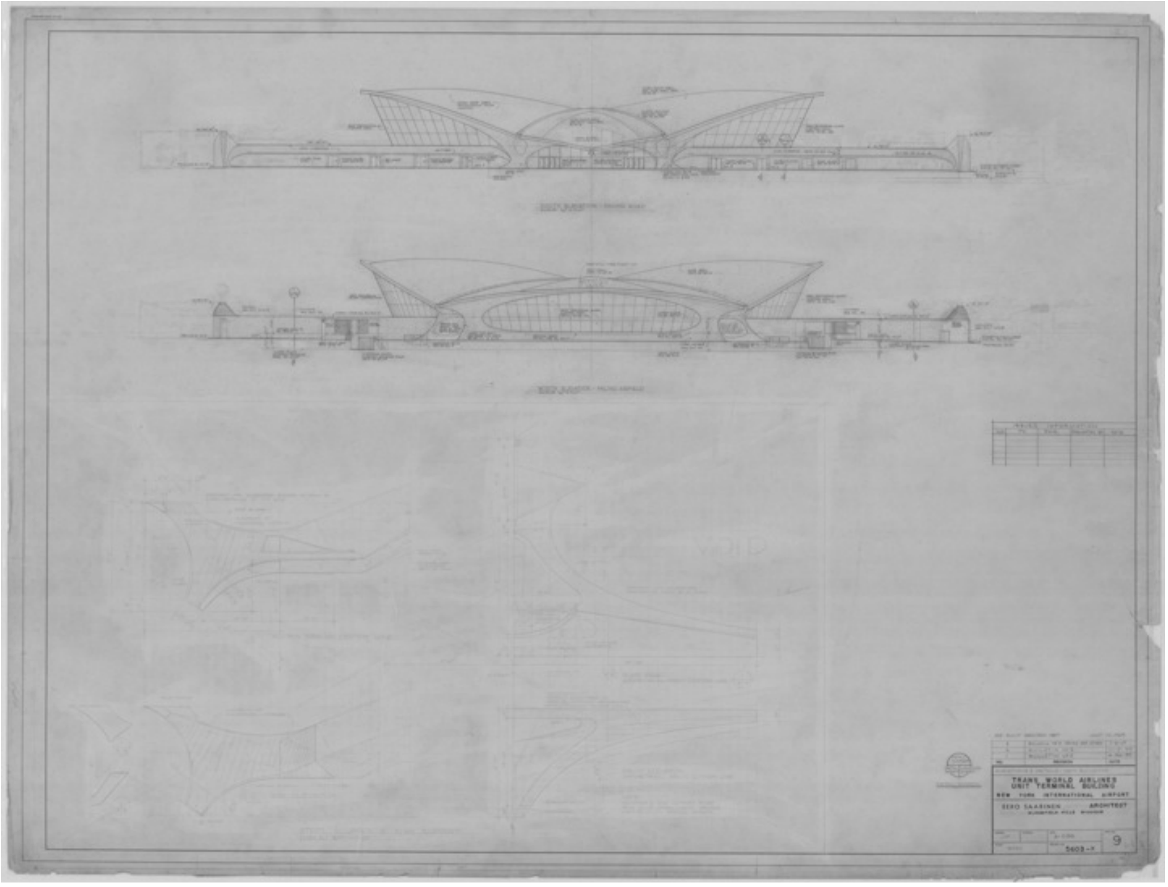


SUMMARY

	Number of Values Used for Average	Average
Terminal		
Date		
Equipment Type		
Flight Number		
Pass Off		24
Pass On		27
Touch Down – Begin Taxi	8	0:30
Begin Taxi – Plane in Position	8	2:20
Plane in Position – Door Opened	19	0:56
Door Opened – Last Pass Out	19	2:24 *
Pass Load'g Begun – Pass. Load'g Complete	11	10:22
Button Up – Leave Ramp	13	2:44
Leave Ramp – Wait for T.O.	6	2:31
Wait for T.O. – Begin T.O.	6	1:22
Begin T.O. – Wheels Off	3	0:24
Aero Bridge: Start – Stop	3	1:55
Start – Stop	2	1:34

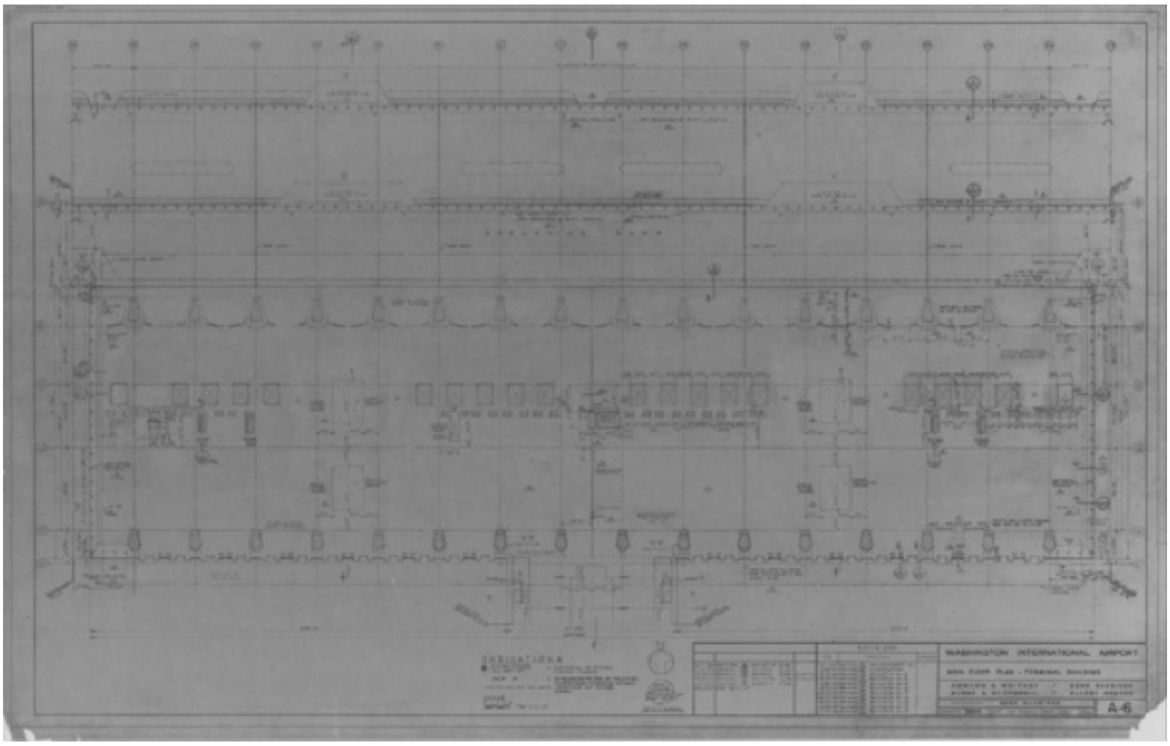
* MAJORITY OF FLIGHTS OBSERVED INDICATE THAT
A) LAST 10 PASS. REQ'D 1:50 MIN.
B) ALL OTHERS REQ'D 3 SEC. EA.
∴ 60 PASS REQ = 1:50
+ (60-10)(0:03) = 2:30
TOTAL TO DEPLANE = $\boxed{\text{4:00 MIN}}$

1.3. *Eero Saarinen: airport study notes*

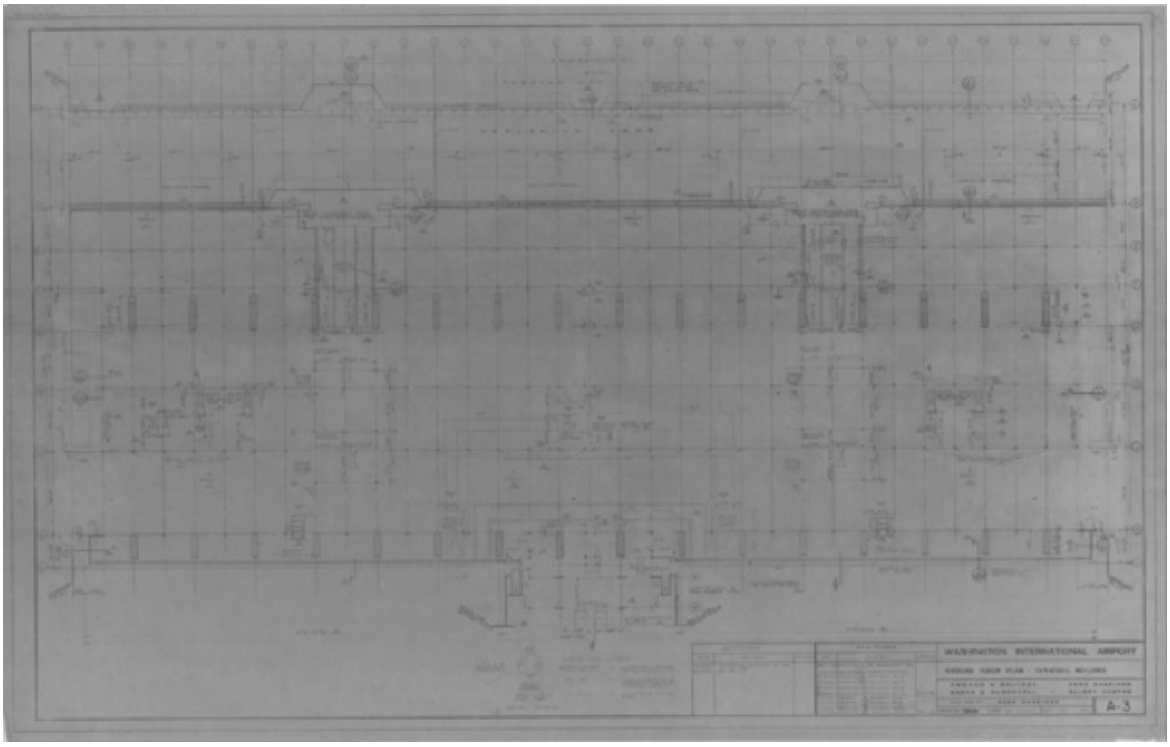


1.4. Trans World Airlines Terminal, New York, NY, elevations, main building

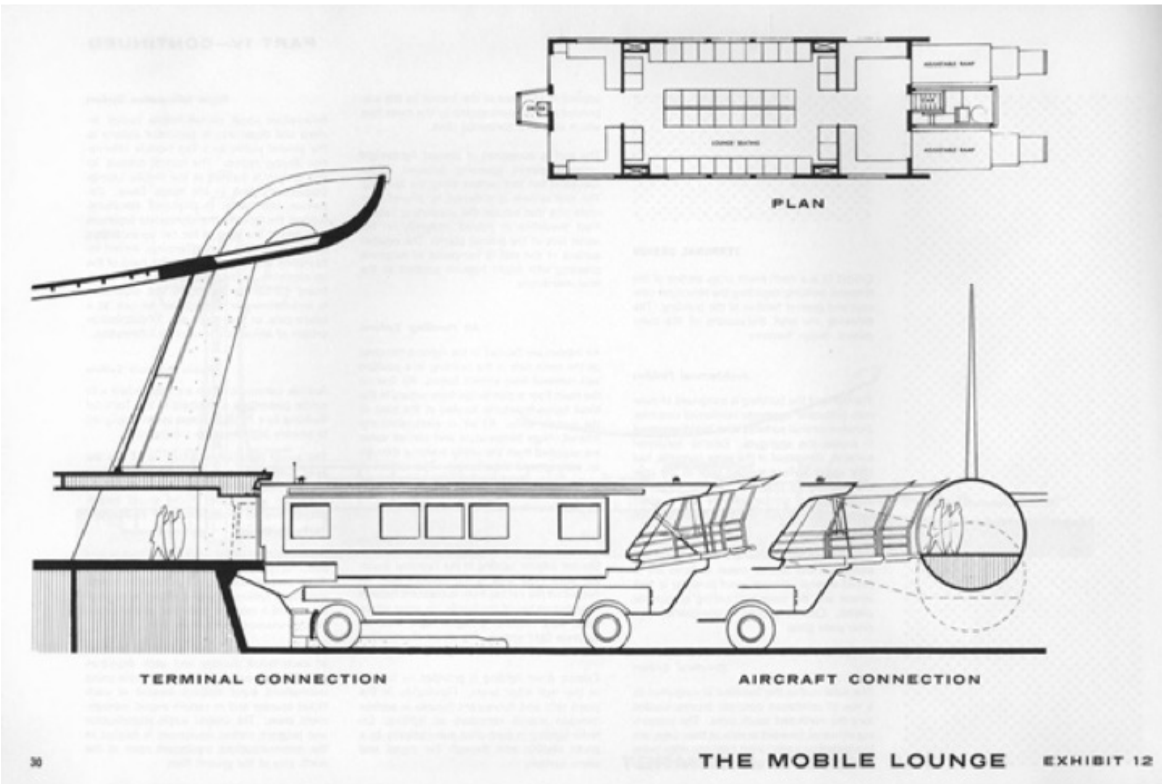
1.5. Eero Saarinen: Dulles International Airport, Chantilly, Virginia, 1958-63, photo: Balthazar Korab, courtesy of The Library of Congress



1.6. Dulles International Airport, Chantilly, VA, main floor plan

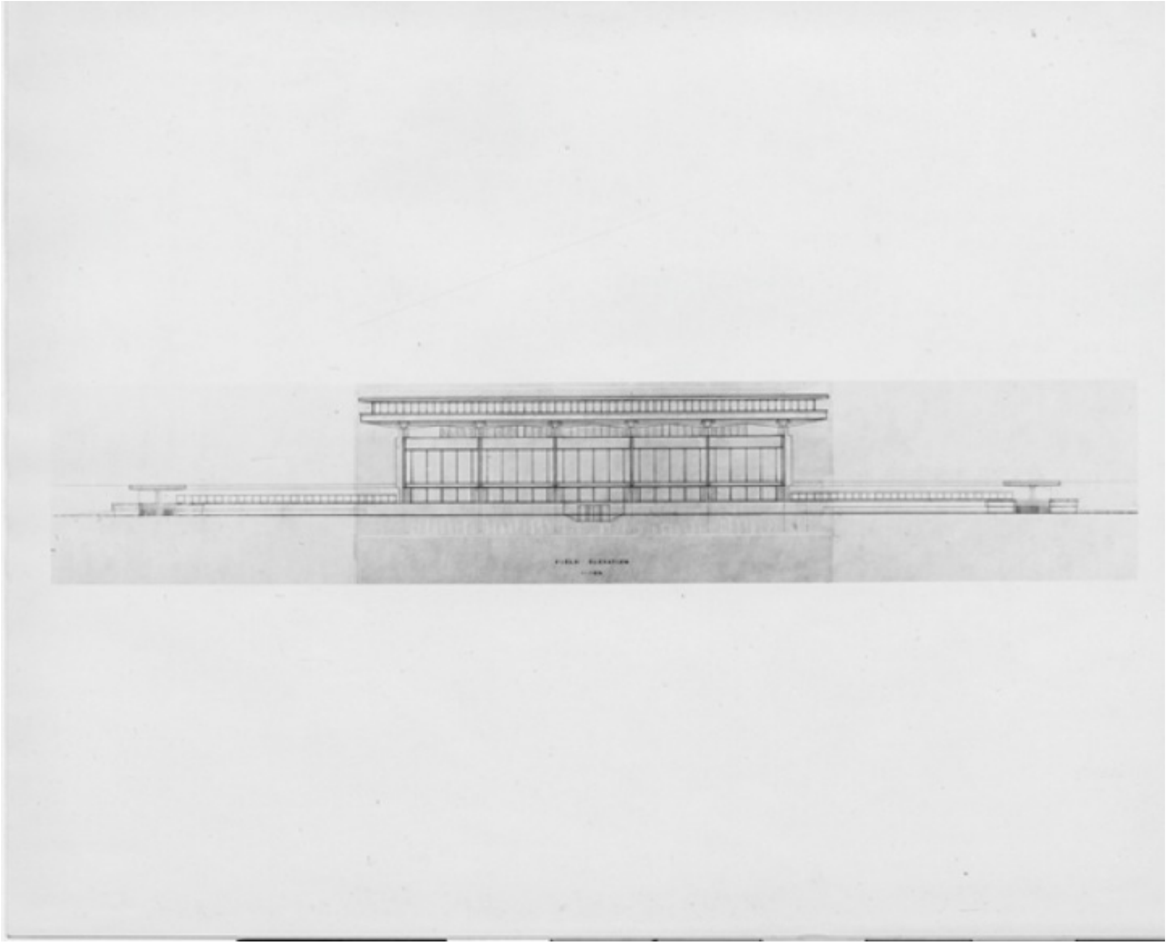


1.7. Dulles International Airport, Chantilly, VA, ground floor plan



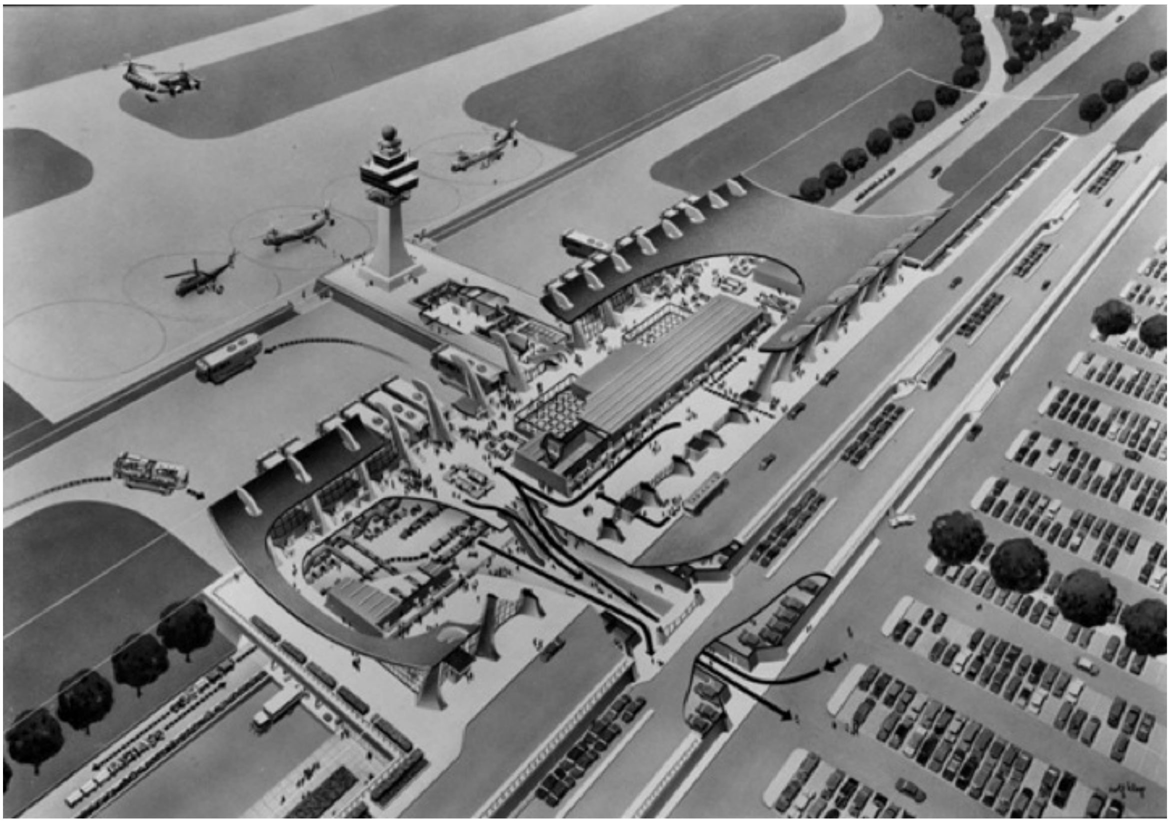
1.8. Dulles International Airport, Chantilly, VA, diagram of mobile lounge docking

1.9. Eero Saarinen: Athens International Airport, Athens, Greece, 1958-69, in the 1970s

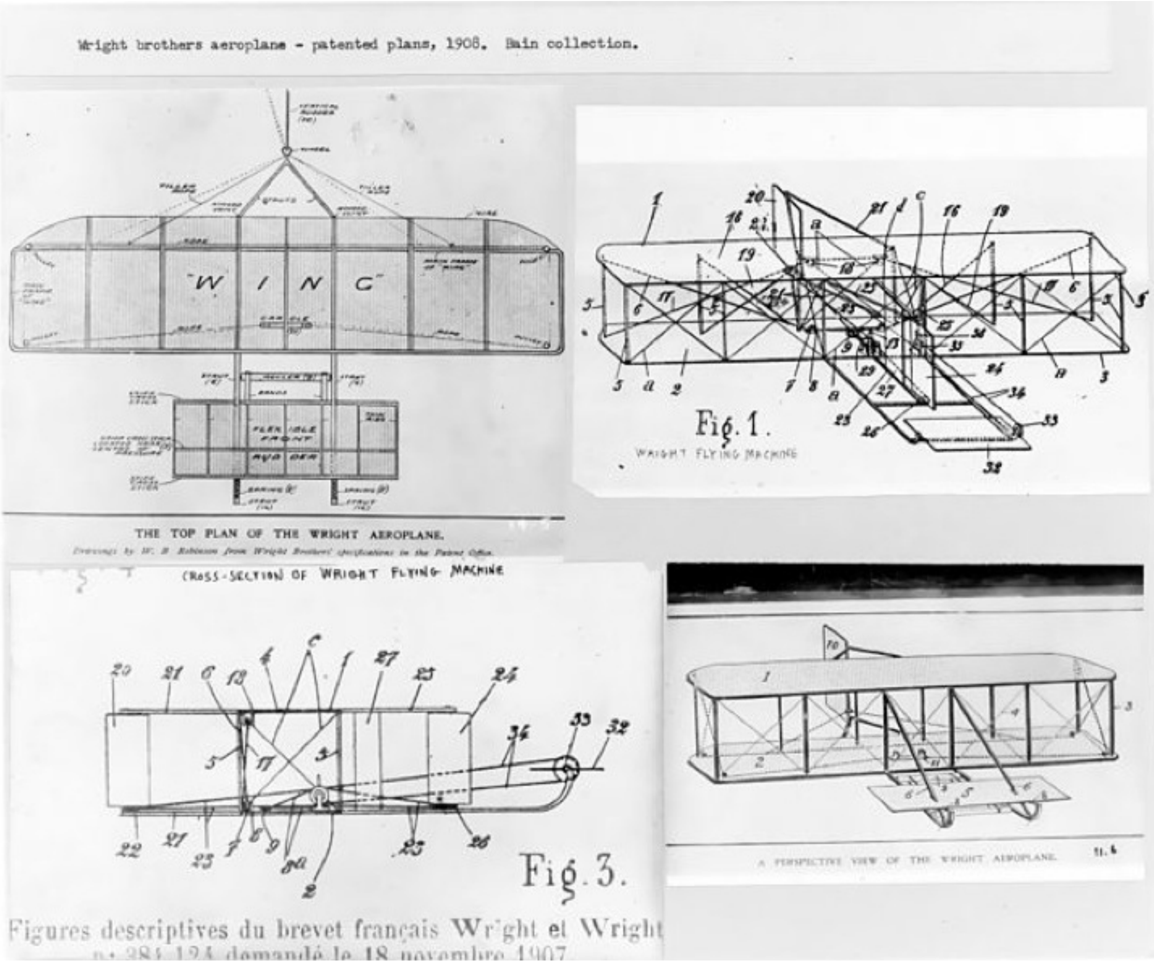


1.10. Athens International Airport, Athens, Greece, elevation

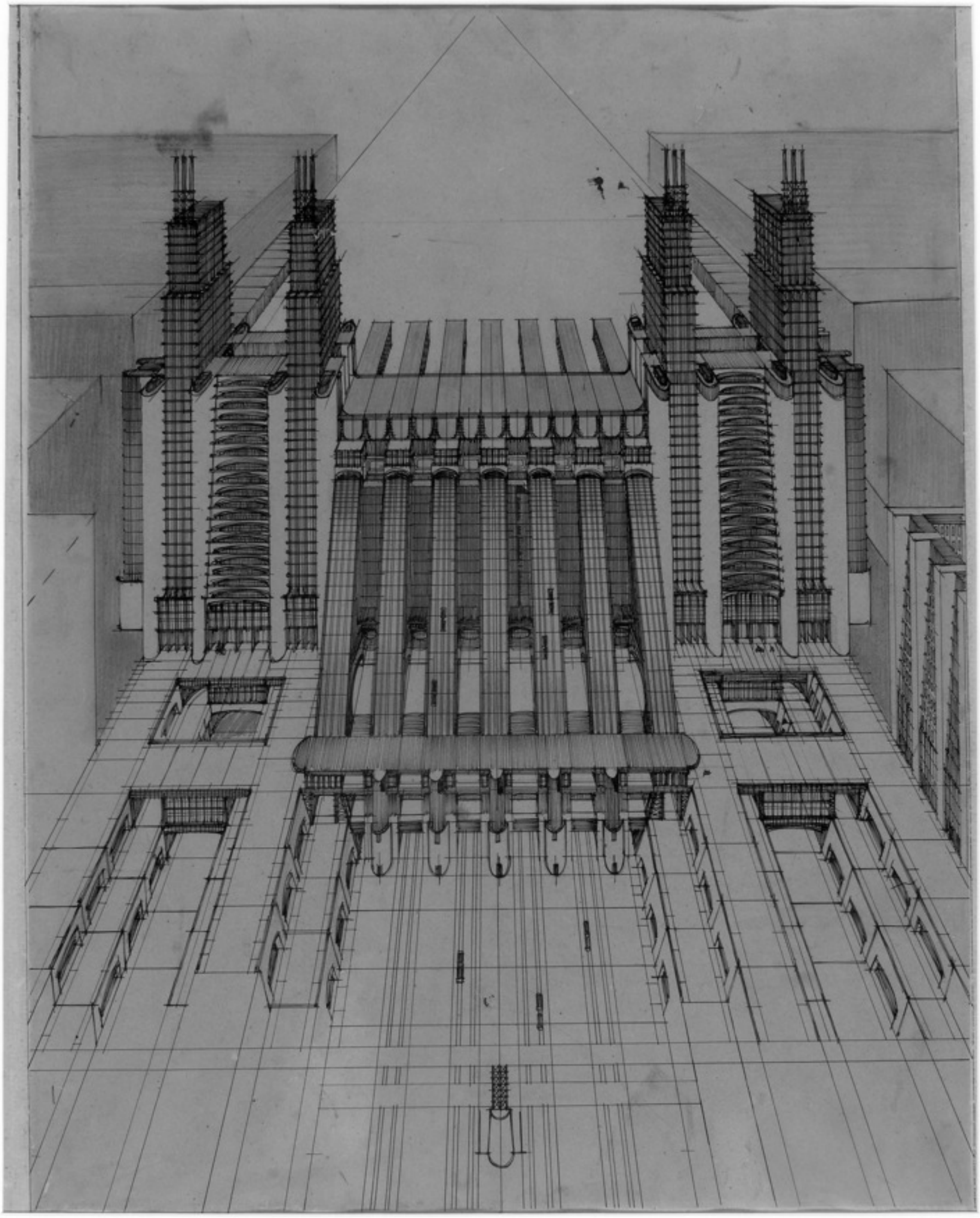
1.11. Time magazine cover featuring Eero Saarinen with site plan of General Motors Technical Center (July 2, 1956)



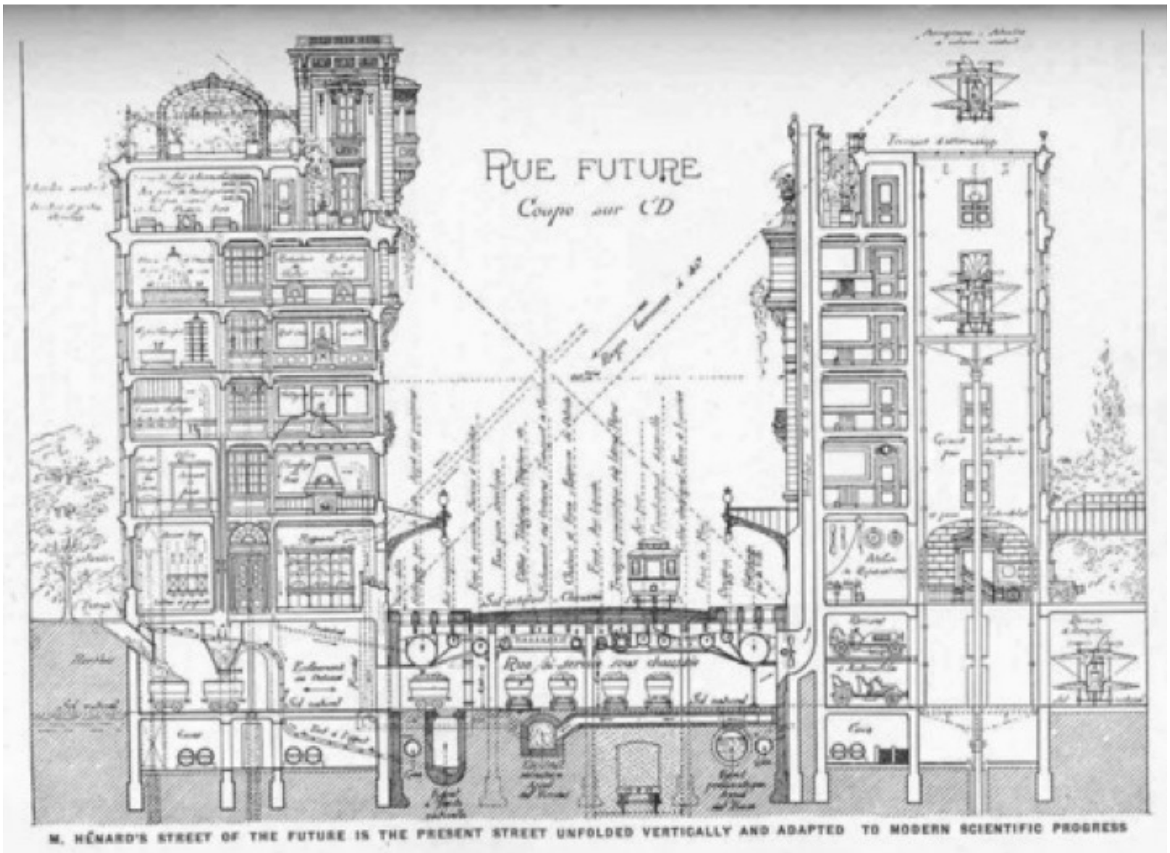
2.1. Dulles International Airport, Chantilly, VA, circulation diagram



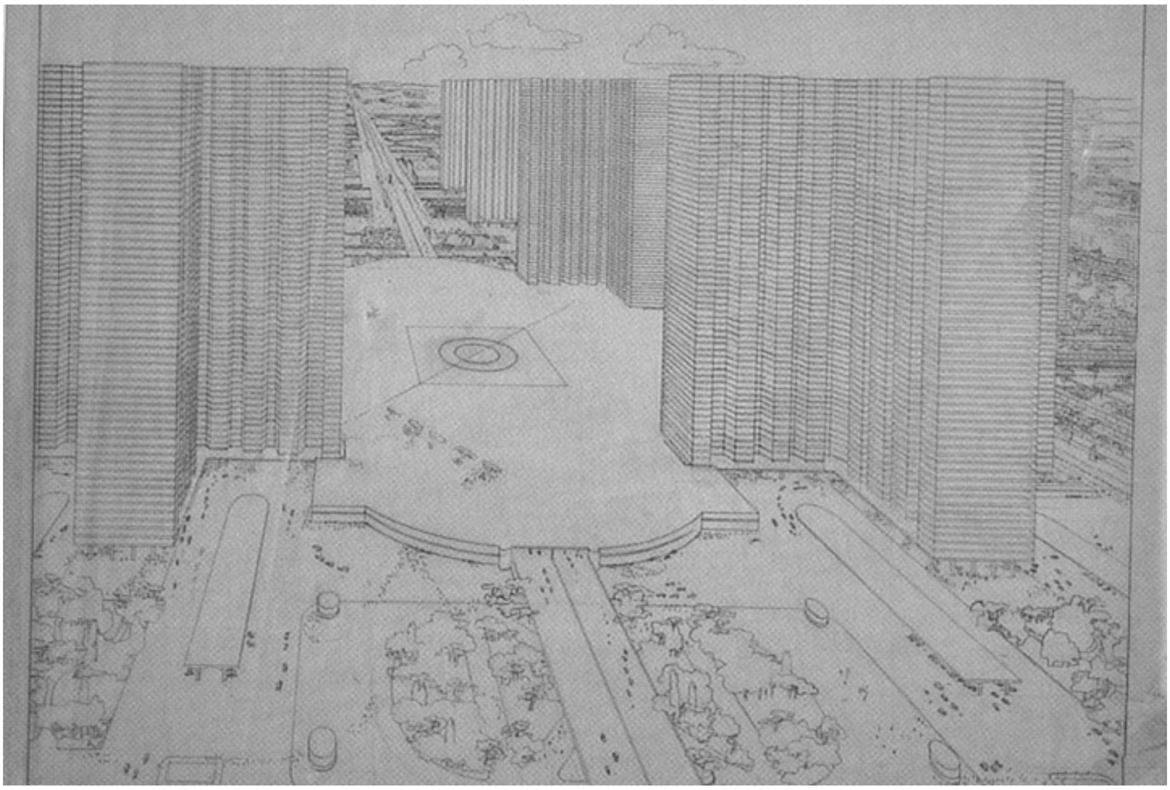
3.1. Wright brothers patented plans, 1908, courtesy of The Library of Congress Prints and Photographs Division Washington, D.C.



3.2. Antonio Sant'Elia: Central station, La Città Nuova, 1912-1914, as published in Utopie metropolitane, la mostra, L'Espresso (March 28, 2013)

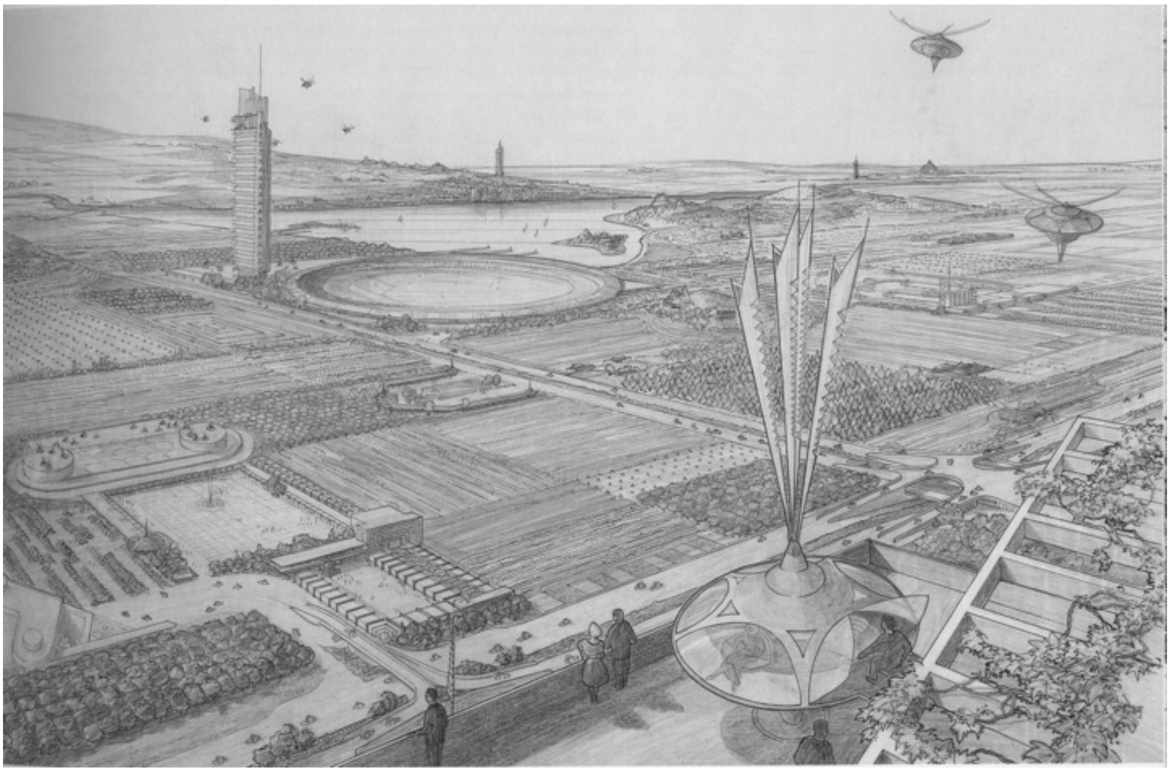


3.3. Eugène Hénard: Rue Future, illustration for The Cities of the Future, American City (January 1911)

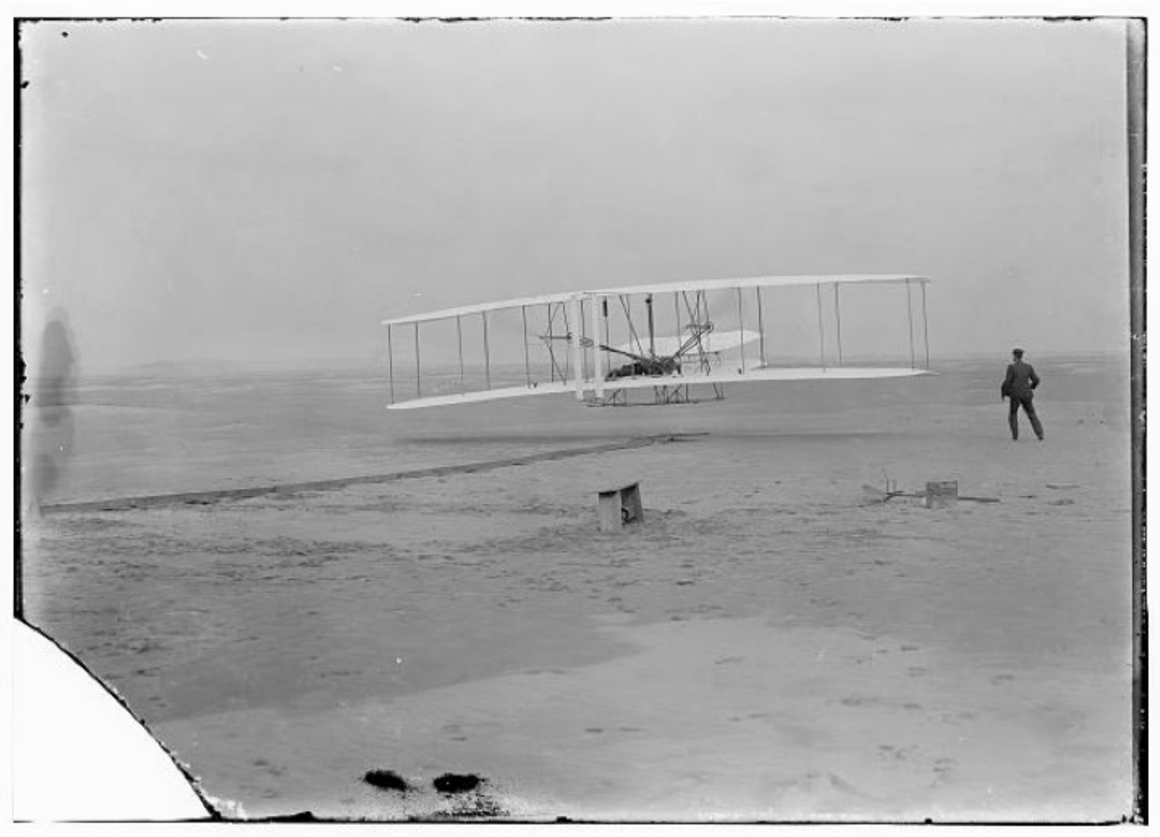


3.4. Le Corbusier: Une Ville Contemporaine, 1922, from The City of To-morrow and Its Planning (New York, 1929)

3.5. Farman F.60 Goliath, ca. 1920 (operational 1919-1931), Eigenes Archiv, Orginal stammt aus Museo MNA Argentina



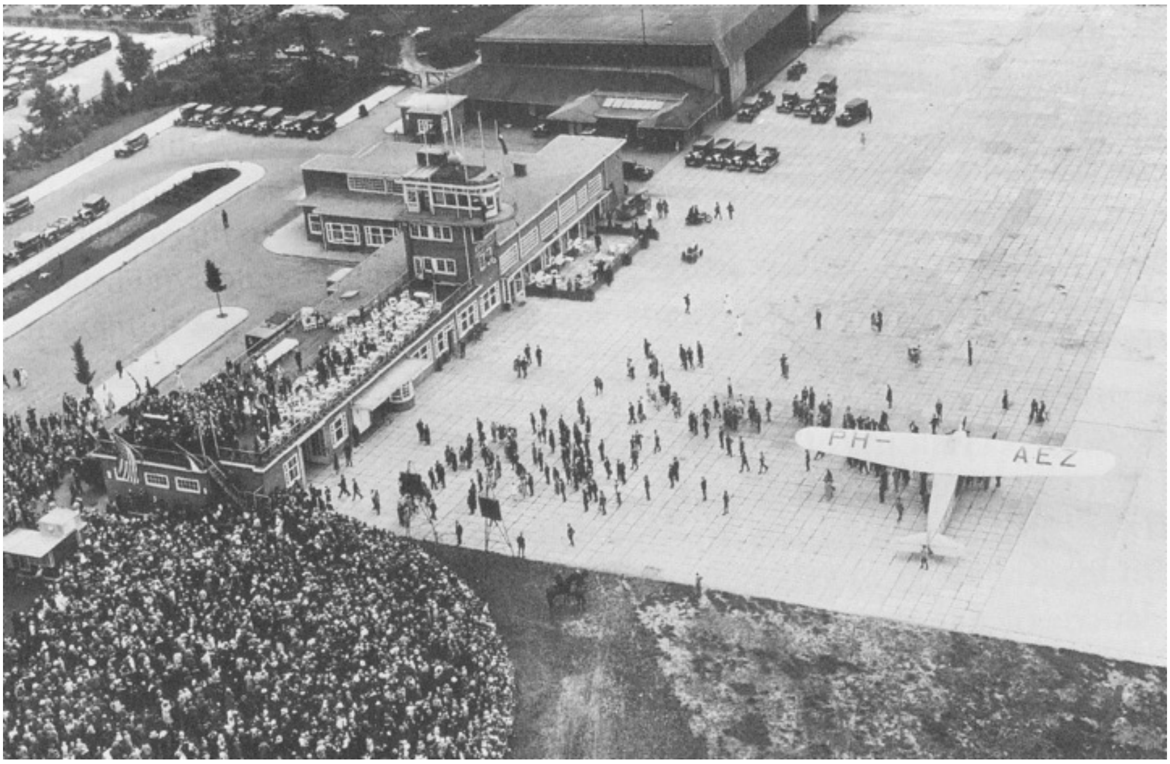
3.6. Frank Lloyd Wright: Broadacre City from The Living City (New York, 1958)



4.1. The first flight, 120 feet in 12 seconds, December 17, 1903, 10:35 a.m. at Kitty Hawk, North Carolina, courtesy of The Library of Congress Prints and Photographs Division Washington, D.C.

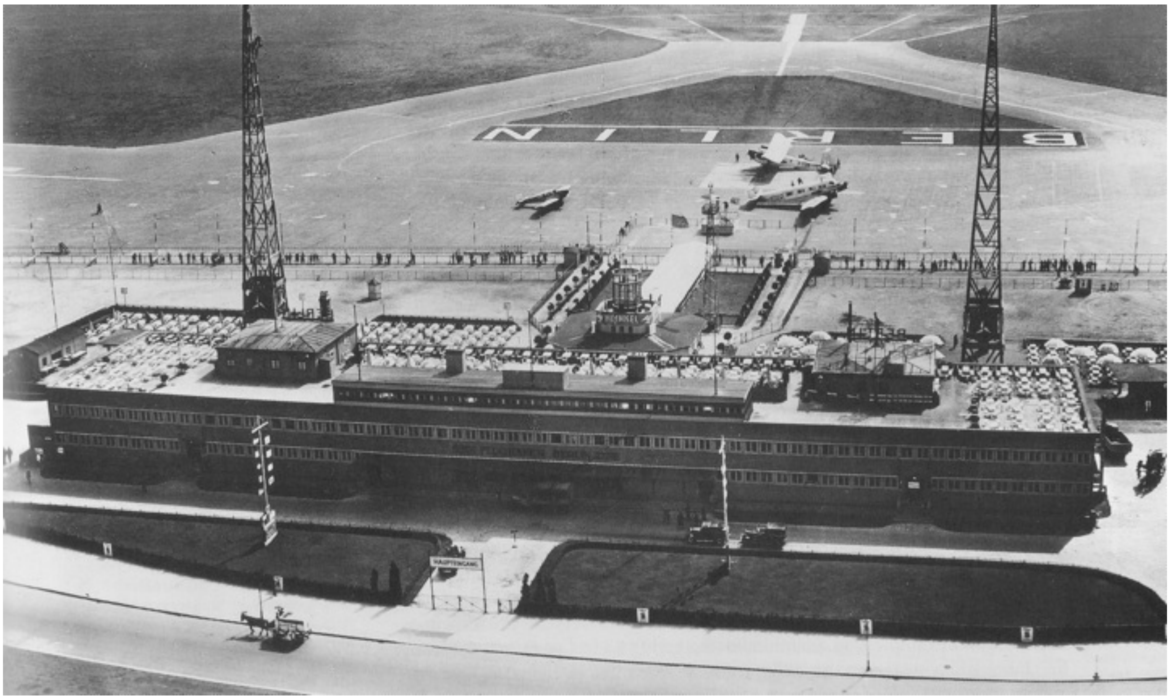
4.2. Air meeting in Reims, France, 1909, from Livre d'or de la conquête de l'air (1909)

4.3. Sous-Secretariat de l'Aéronautique: Le Bourget Airport, Paris, France, 1922, from Pearman, Hugh. Airports: A Century of Architecture (New York, 2004)

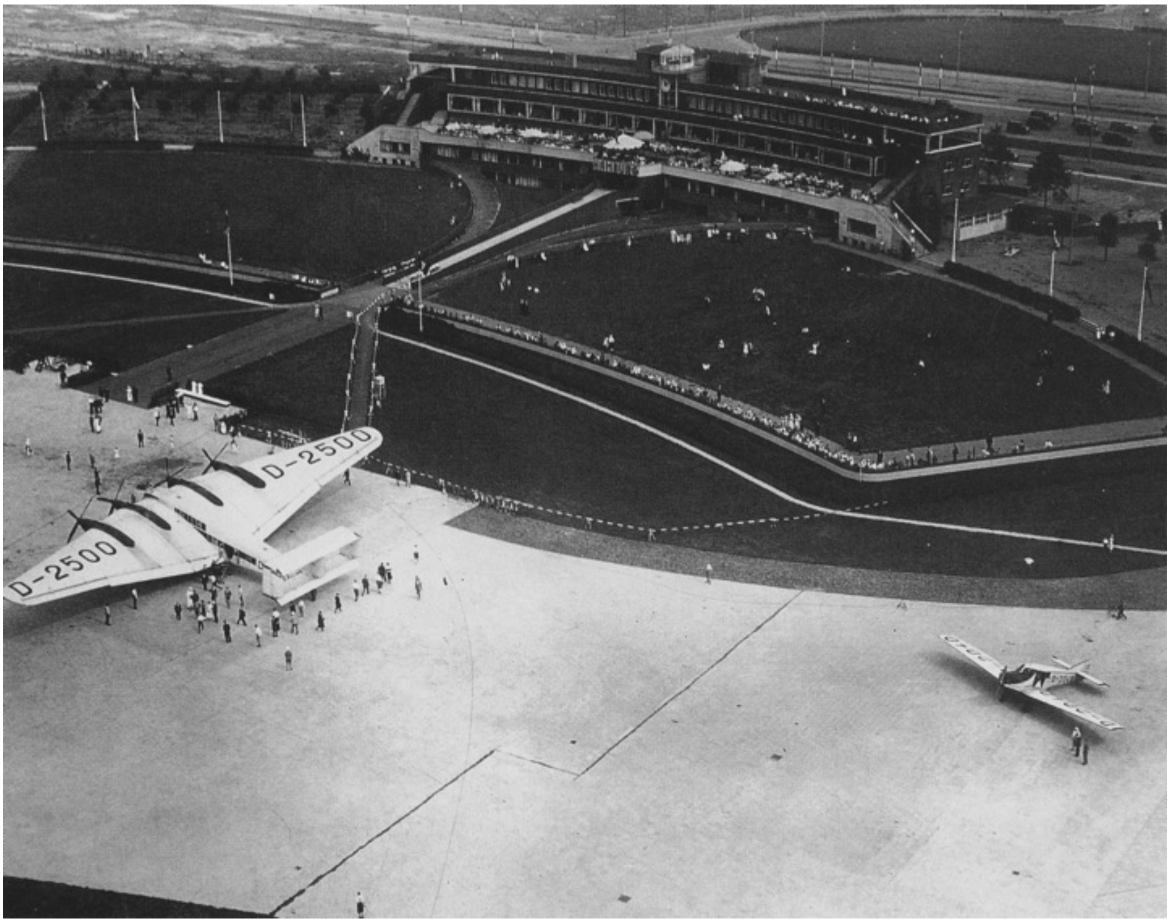


4.4. Dirk Roosenburg: Schiphol Airport, Amsterdam, The Netherlands, 1929, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)

4.5. Luis Gutiérrez Soto: Barajas Airport, Madrid, 1929-31, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)



4.6. Paul and Klaus Engler: Tempelhof Airport, Berlin, Germany, 1926-29, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)



4.7. Friedrich Dyrssen and Peter Averhoff: Fuhlsbüttel Airport, Hamburg, Germany, 1928-29, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)

4.8. Hans Wittwer: Halle-Leipzig Airport restaurant, Germany, 1929, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)

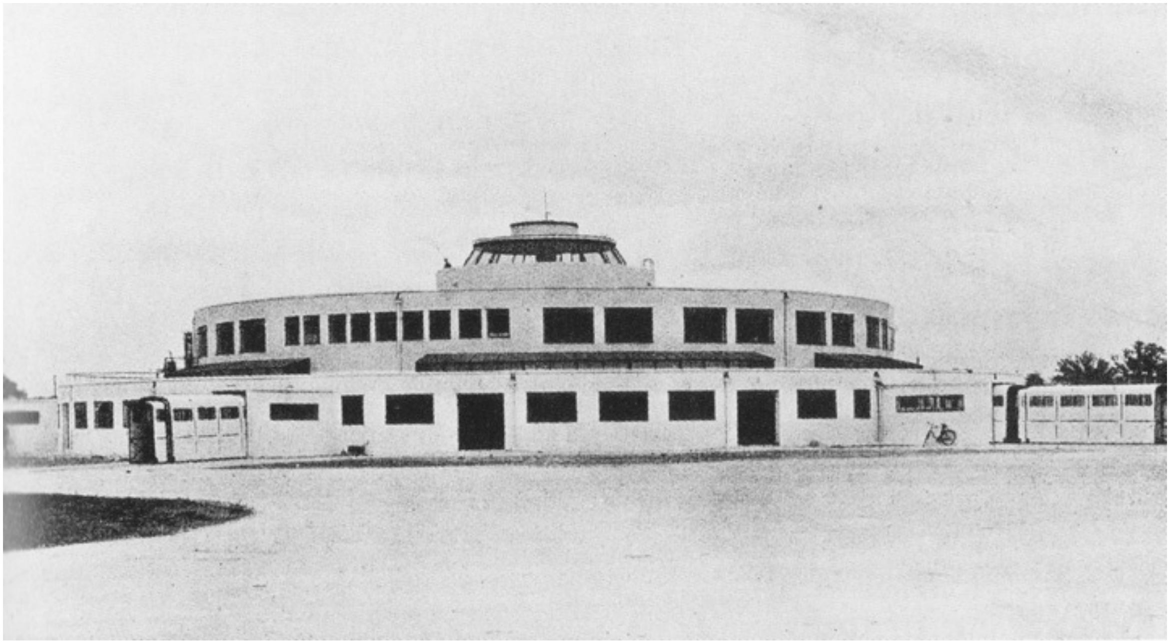
4.9. Albert Kahn: Ford Airport, Dearborn, Michigan, 1927

4.10. Delano and Aldrich: International Air Terminal and Dinner Key Seaplane Base, Miami, Florida, 1934, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)

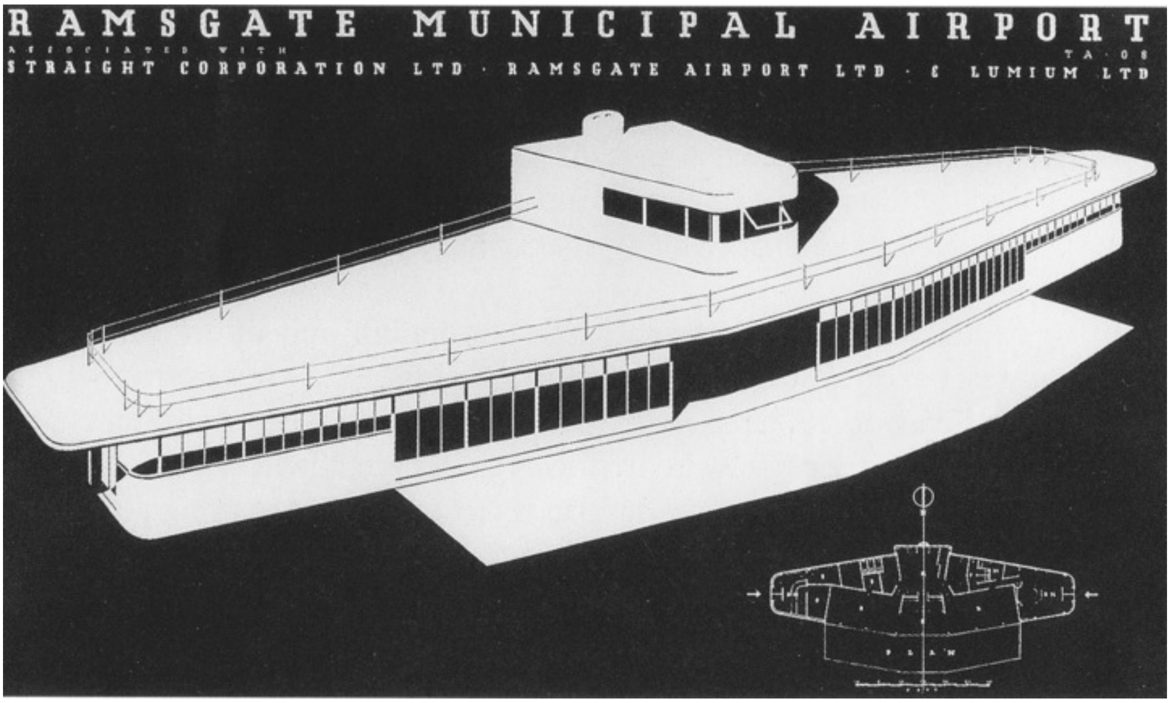
4.11. Holden, Stott and Hutchinson: Washington-Hoover Airport, Washington, D.C., 1930, courtesy of the Metropolitan Washington Airport Authority

4.12. Georges Labro: Le Bourget Airport, Paris, France, 1936-37, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)

4.13. Ernst Sagebiel: Tempelhof Airport, Berlin, Germany, 1936-39, from Pearman, Hugh. Airports: A Century of Architecture (New York, 2004)



4.14. Hoar, Marlow and Lovett: Gatwick Airport, London, United Kingdom, 1936, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)



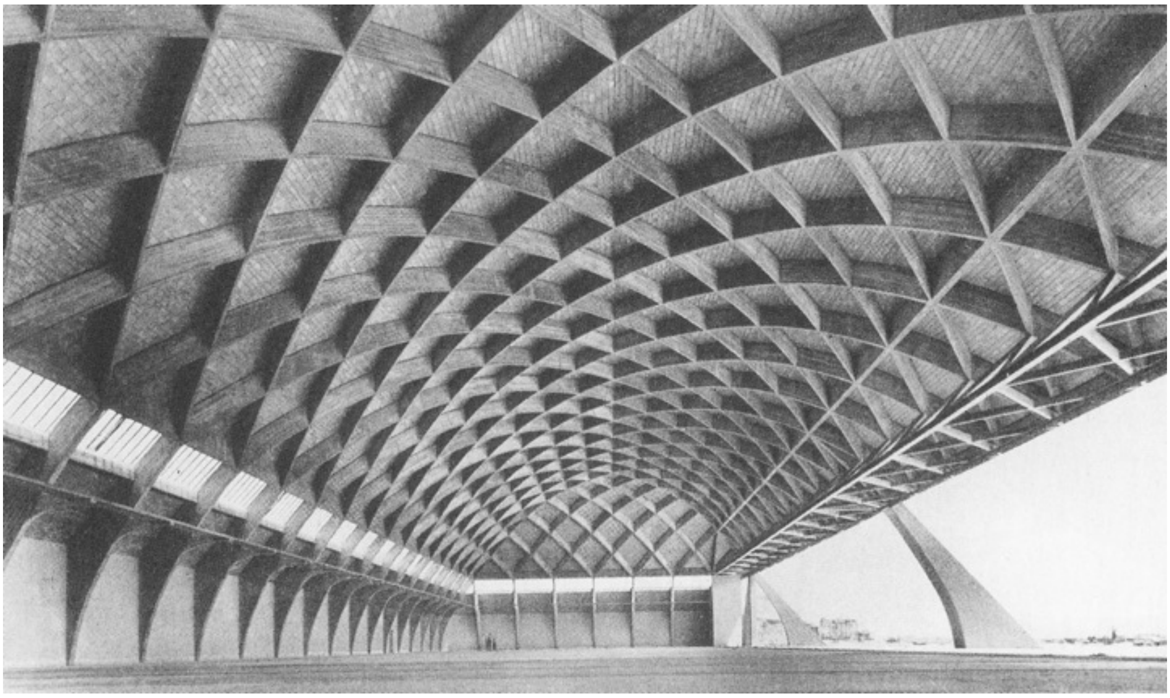
4.15. D. Pleydell-Bouverie: Municipal Airport of Ramsgate, United Kingdom, 1937, from Architectural Review (July 1937)

4.16. Paul Hedquist: Stockholm-Bromma Airport, Sweden, 1935-36, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)

4.17. Gianluigi Giordani: Milan-Linate Airport, Italy, 1935-37, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)

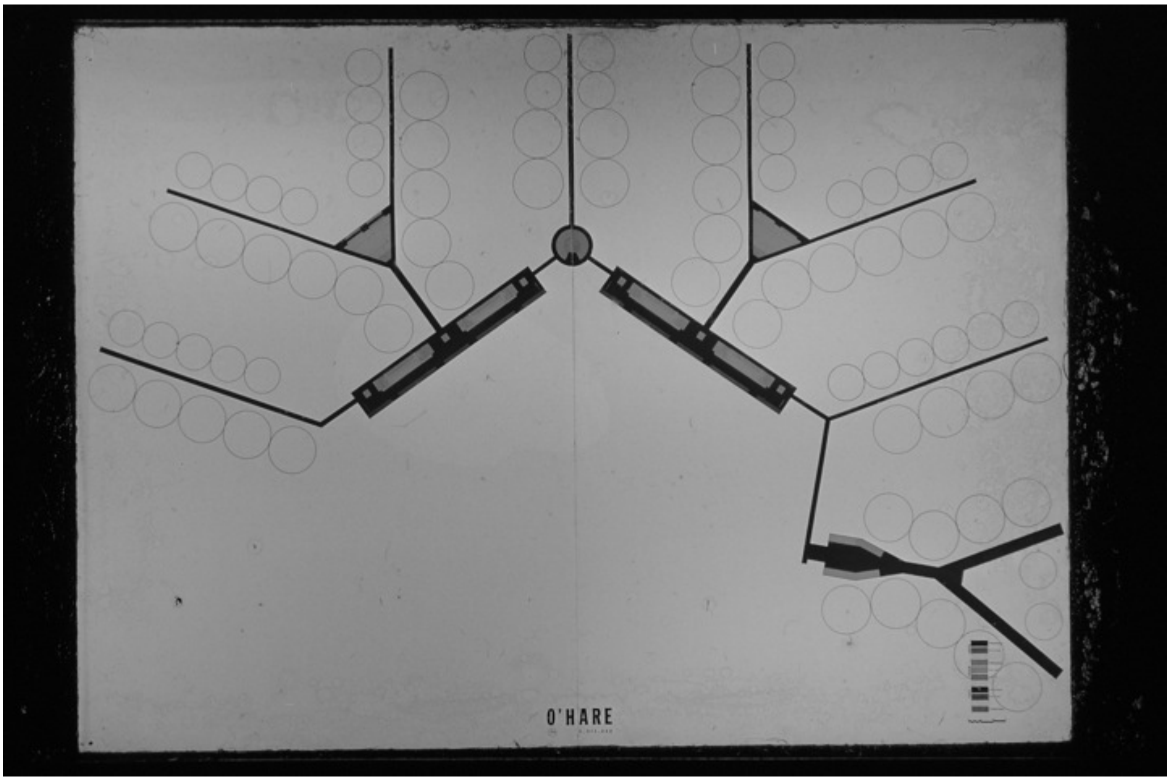
4.18. Howard Lovewell Cheney and Charles M. Goodman: Washington National Airport, Washington, D.C., 1941, photo: Jack Delano, courtesy of The Library of Congress

4.19. Delano & Aldrich: New York Municipal Airport, Marine Terminal, 1937-39, photo: David Sharpe, Historic American Buildings Survey/Historic American Engineering Record, courtesy of The Library of Congress



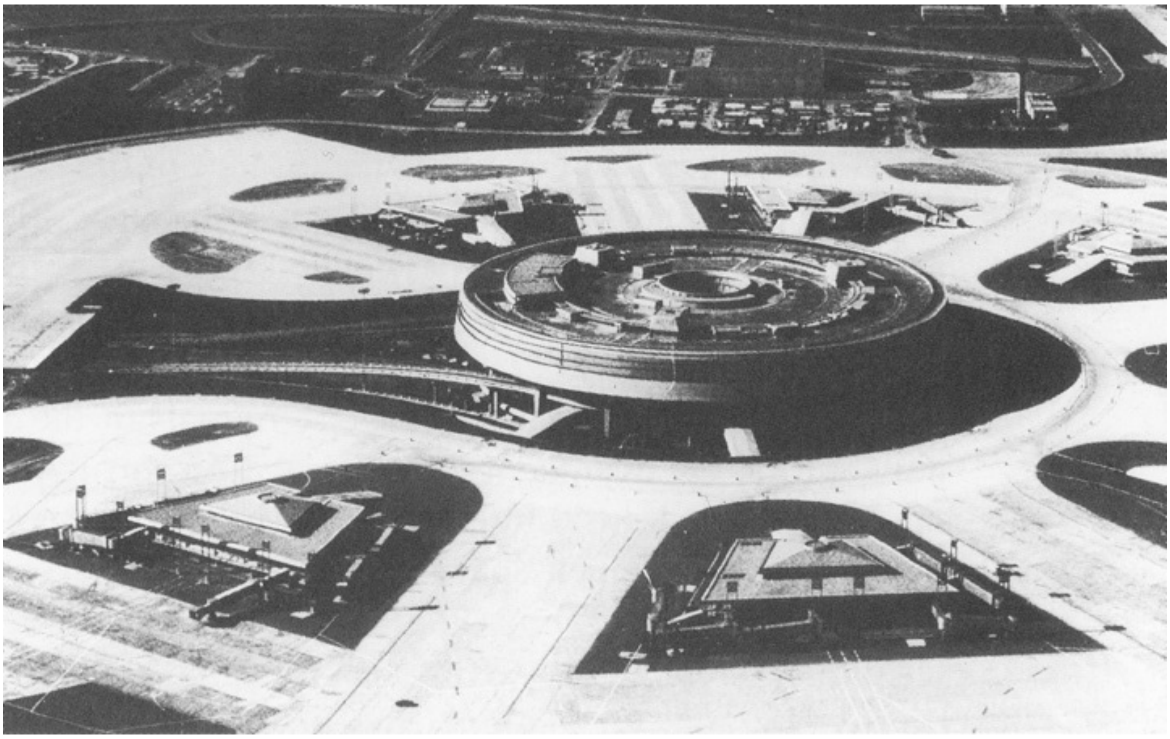
4.20. Pier Luigi Nervi: hangar at Orvieto, Italy, 1935, from Moderne Bauformen (1939)

4.21. C. F. Murphy Associates: O'Hare International Airport, Chicago, Illinois, 1957-63, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)



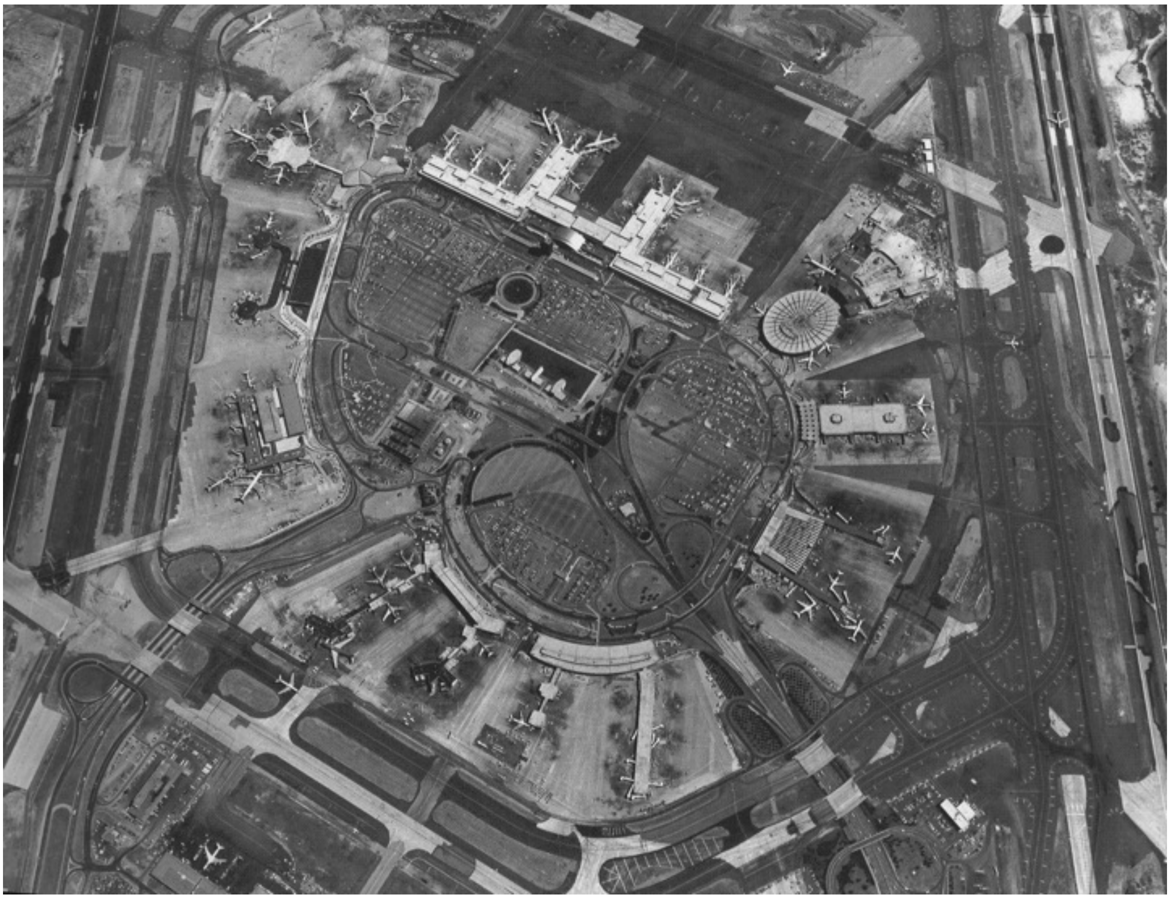
4.22. Eero Saarinen: diagram showing the finger structure of O'Hare International Airport

4.23. Aéroports de Paris, Henri Vicariot: Orly Airport, main hall, Paris, France, 1961, from L'Architecture d'Aujourd'hui (Sept. 1961)



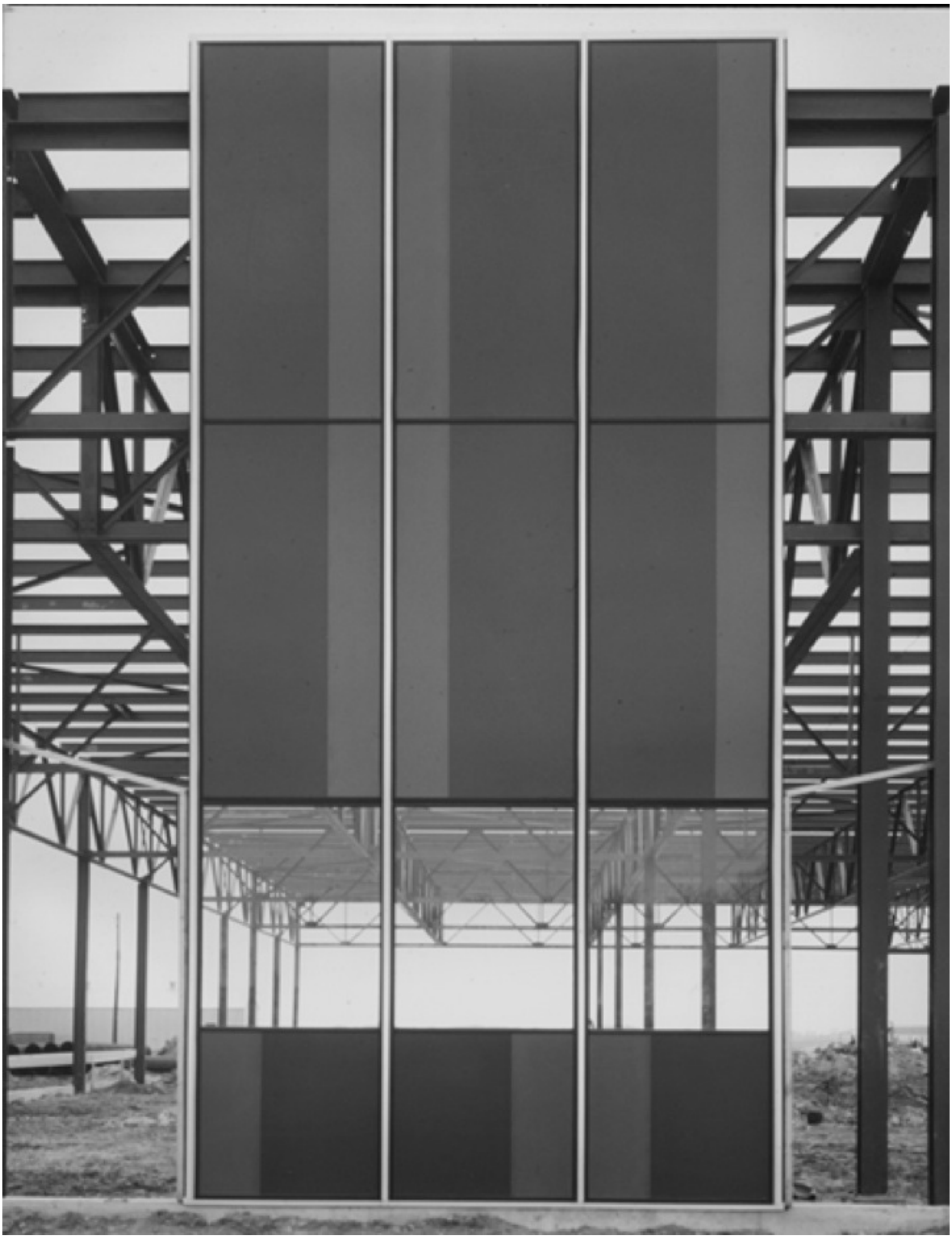
4.24. Aéroports de Paris, Paul Andreu: Terminal 1 and satellites, Charles de Gaulle International Airport, Roissy-en-France, 1967-74, from L'Architecture d'Aujourd'hui (March 1974)

4.25. Hellmuth, Yamasaki and Leinweber: Lambert St. Louis International Airport, Missouri, 1951-56, from Building for Air Travel: Architecture and Design for Commercial Aviation (Munich and New York, 1996)



4.26. New York International Airport, New York (Idlewild, later JFK), 1941-1970, from Pearman, Hugh. Airports: A Century of Architecture (New York, 2004)

4.27. Hellmuth, Obata and Kassabaum: Dallas-Fort Worth International Airport, Texas, 1965-73, from Pearman, Hugh. Airports: A Century of Architecture (New York, 2004)



5.1. Eero Saarinen: International Business Machines [IBM], Rochester, Minnesota, 1956-58, mock-up of curtain wall

5.2. Eero Saarinen: IBM Thomas J. Watson Research Center, Yorktown, New York, 1956-61, perimeter corridor, photo: George Cserna

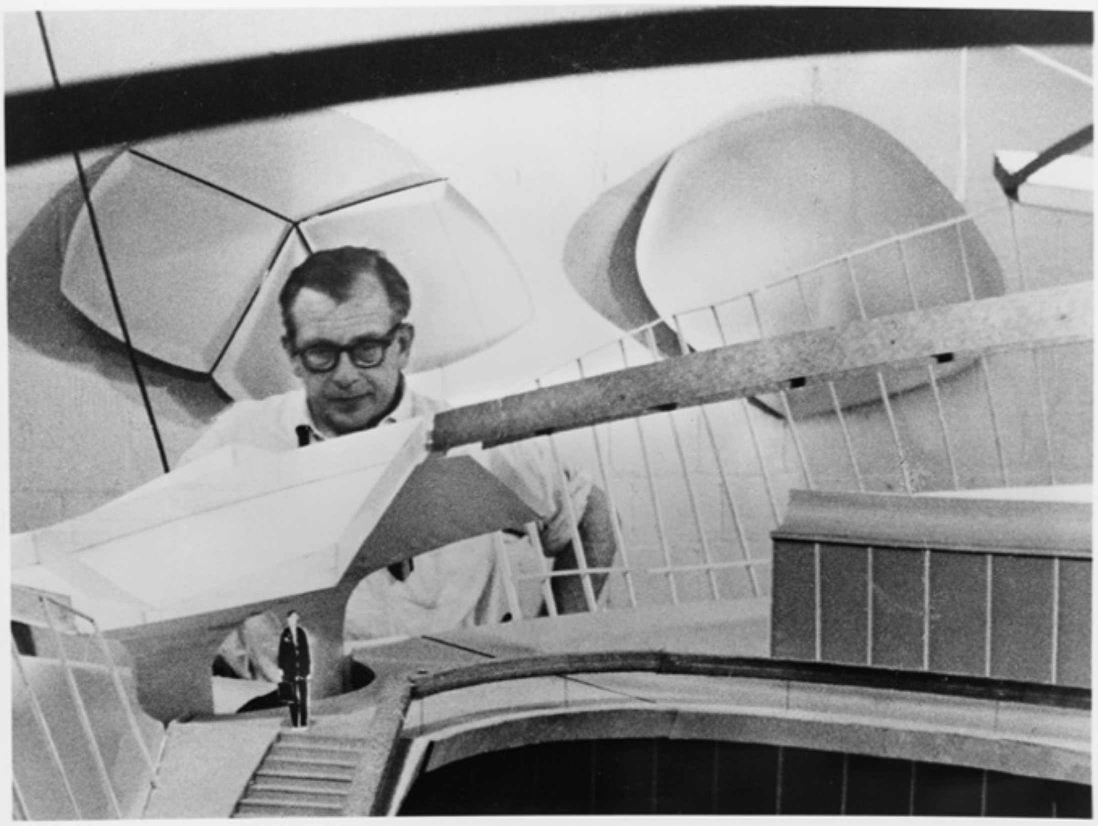
The recently completed Holmdel, N.J., Laboratory, designed by the famed architect, the late Eero Saarinen, is the research and development center for approximately 4,000 Bell Telephone Laboratories employees. The building, 700 feet long and 350 feet deep, is sheathed with a facade of 6,800 panes of specially designed low-brightness mirrored glass which reflects 65 percent of the sun's heat while allowing 15 percent of the light to enter.

B 4539-2

PHOTO

Bell Telephone Laboratories Murray Hill, New Jersey 07971

5.3. Eero Saarinen: Bell Telephone Laboratories, Holmdel, New Jersey, 1957-62, press material



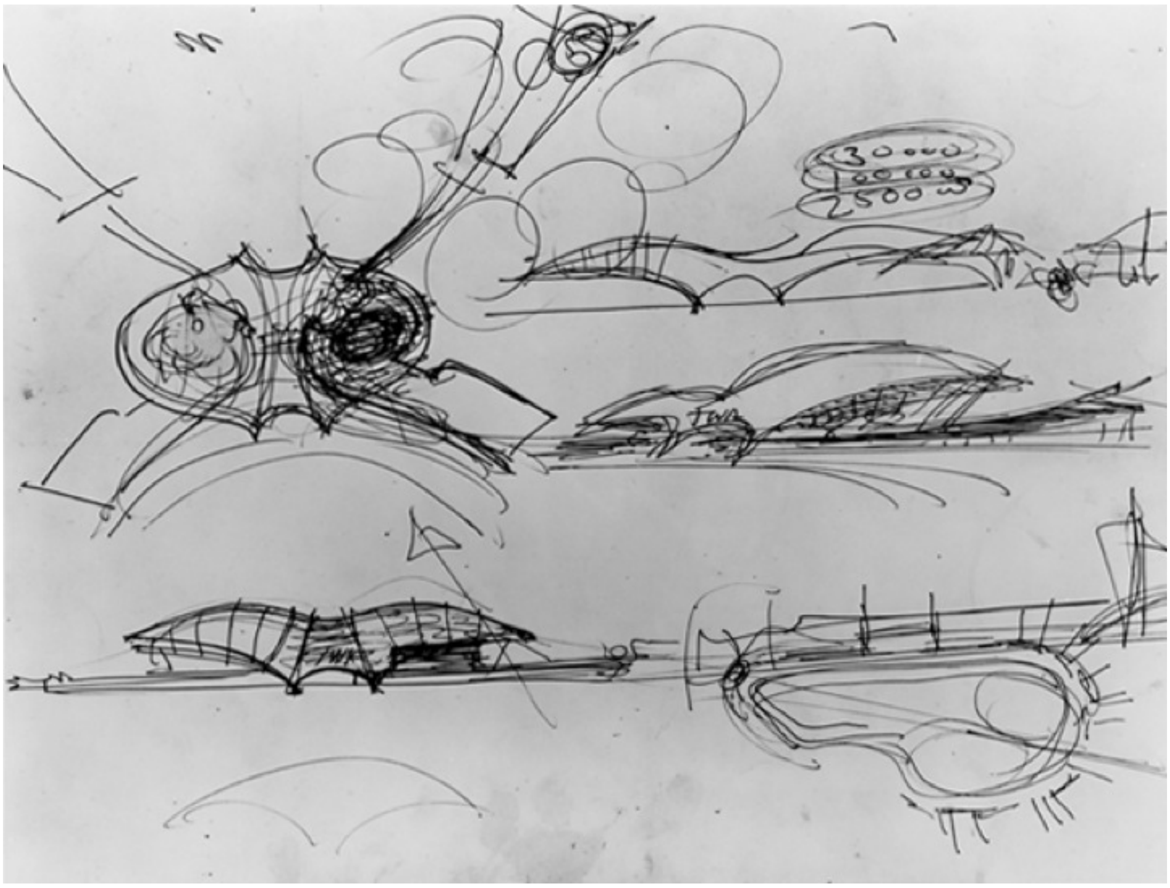
"All the parts of the building -- from stair-railings to the shape of signs -- were studied like parts of a giant, unified piece of sculpture and were actually designed within a one-inch scale cardboard model (so big that the draftsmen could climb into it) with the hope that every part of the building would belong to 'one family of forms.' "

Thus does Mrs. Eero Saarinen, widow of the famed architect who designed the Trans World Flight Center at New York International Airport, describe how it took shape. This photograph, taken by Baltazar Korab, of Birmingham, Michigan, shows Saarinen with the scale model mentioned above.

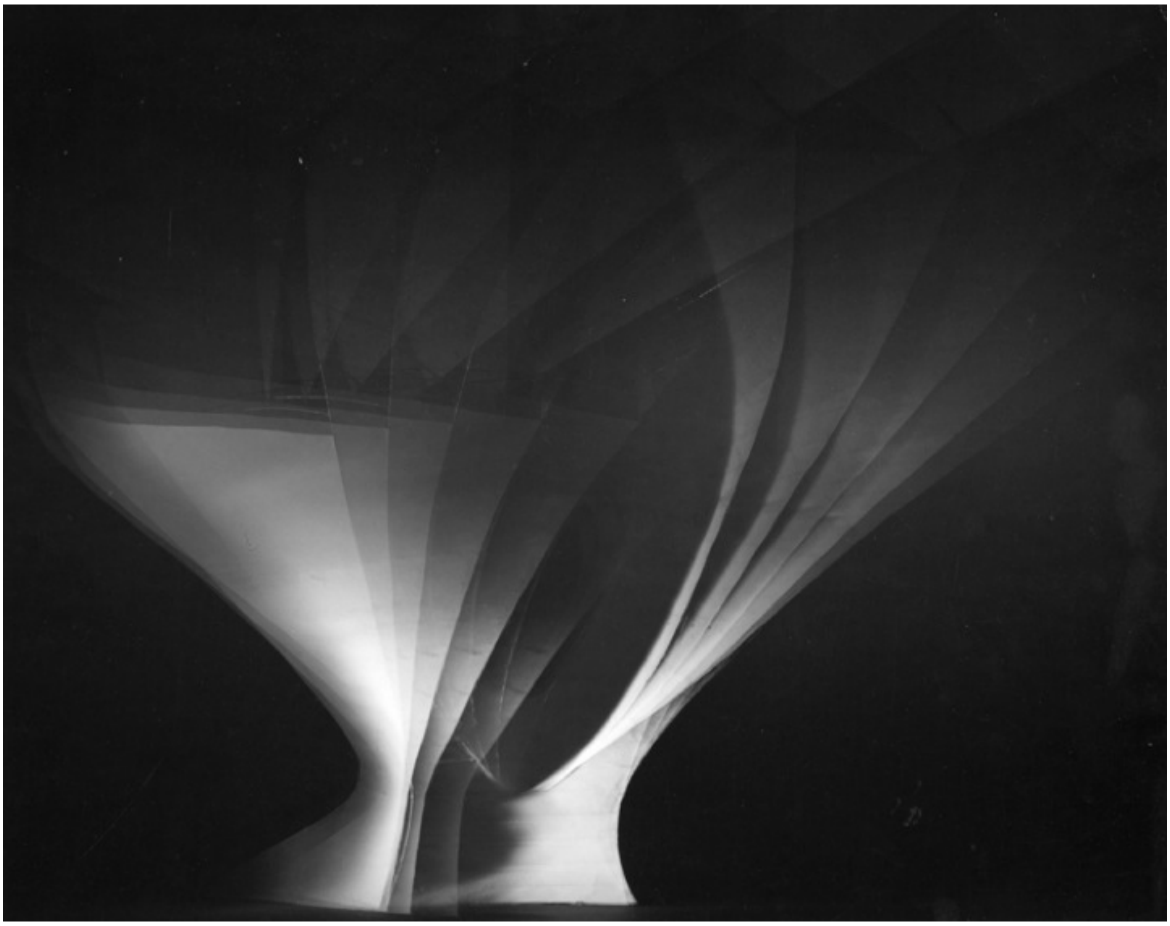
Trans World Airlines Photo

051162

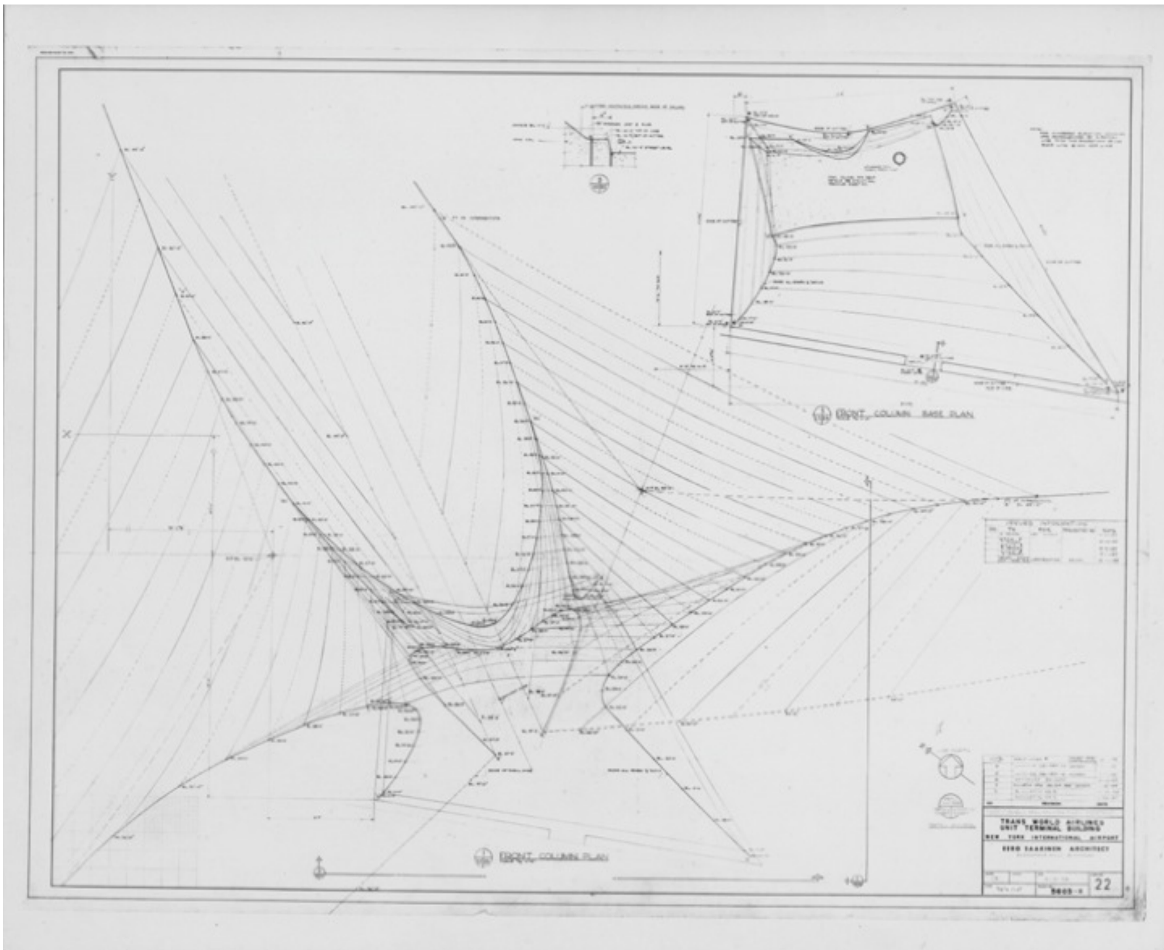
5.4. Work on Trans World Airlines model, TWA press material, photo: Balthazar Korab, courtesy of The Library of Congress



5.5. Eero Saarinen: Sketch of Trans World Airlines Terminal, New York, NY, 1956, reproduced from the back of a restaurant menu

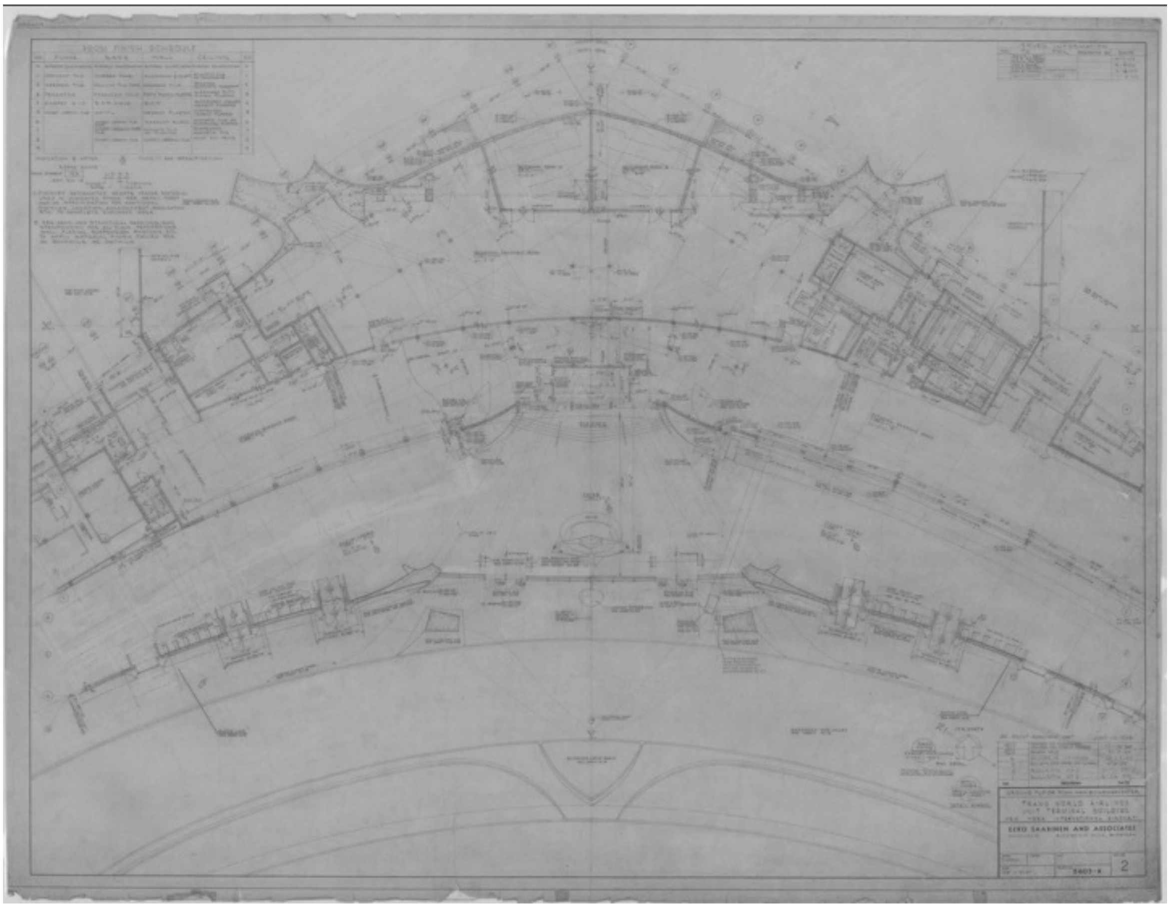


5.6. Trans World Airlines Terminal, New York, NY, light study, photo: Balthazar Korab, courtesy of The Library of Congress

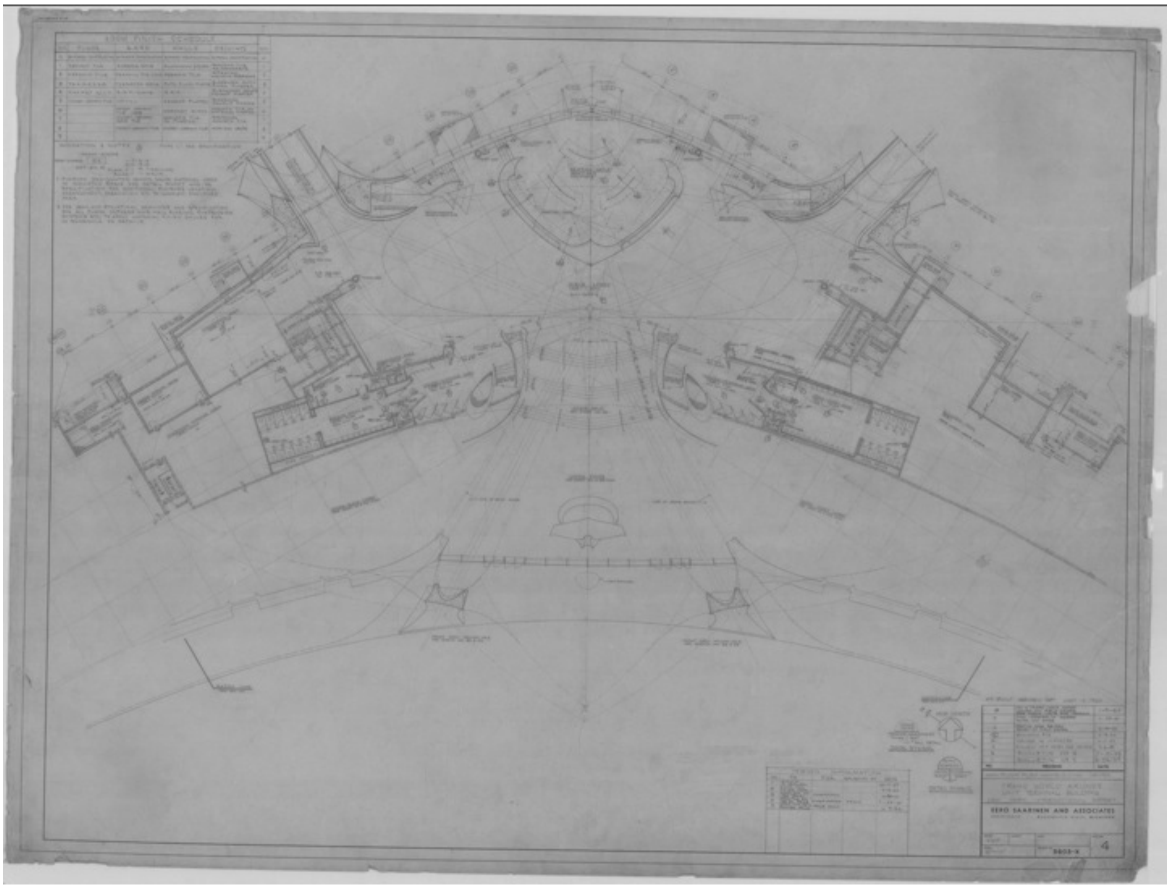


5.7. *Trans World Airlines Terminal, New York, NY, contour drawing*

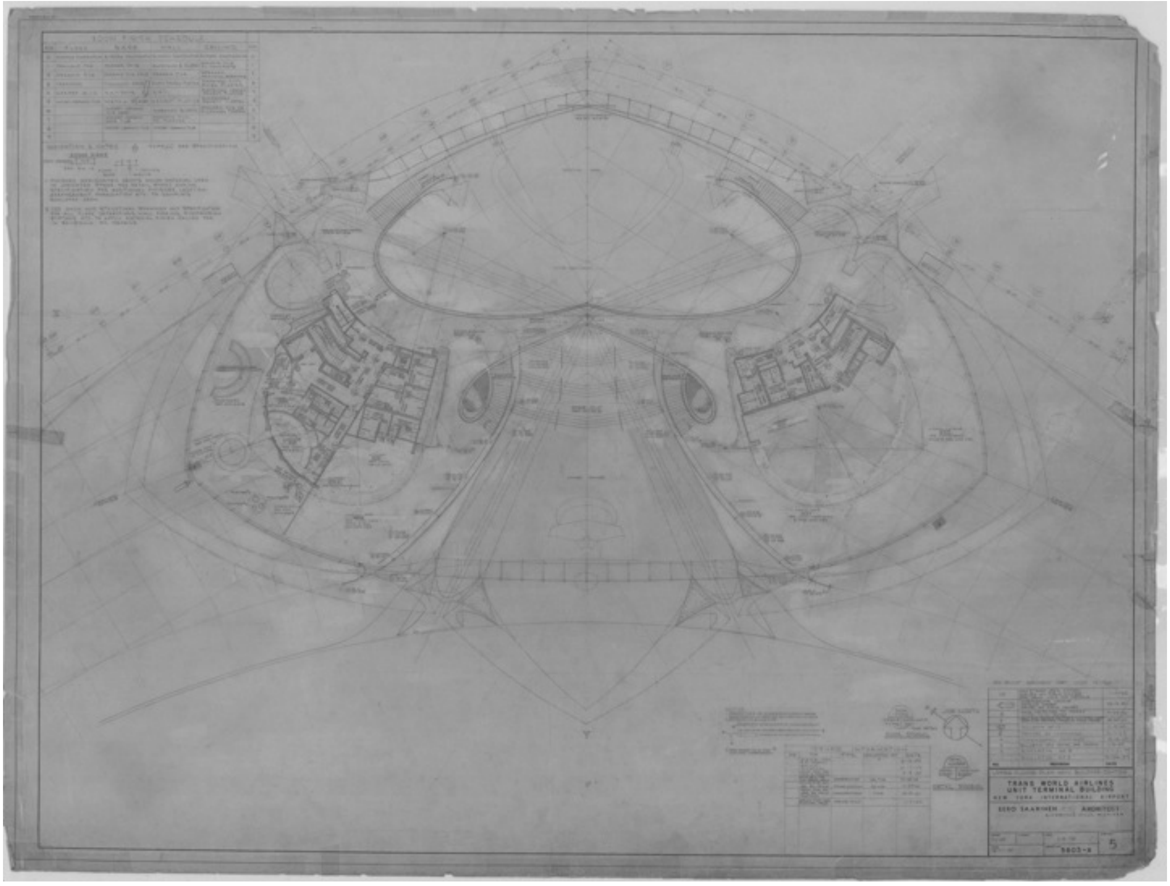
5.8. Trans World Airlines Terminal, New York, NY, construction of the roof



5.9. Trans World Airlines Terminal, New York, NY, ground floor plan, main building



5.10. Trans World Airlines Terminal, New York, NY, main floor plan, main building



5.11. Trans World Airlines Terminal, New York, NY, upper floor plan, main building

5.12. Trans World Airlines Terminal, New York, NY, ground and main floor plans, main building, wings

The striking helicopter view shows the complete expanse of the new Trans World Flight Center at New York International Airport, designed by the late Eero Saarinen. The soaring central structure, containing check-in, baggage claim and main waiting areas, suggests the flight of a giant bird. A spacious passageway leads to the Flight Wing which features comfortable lounges for each of seven gate positions for jet aircraft.

Trans World Airlines Photo

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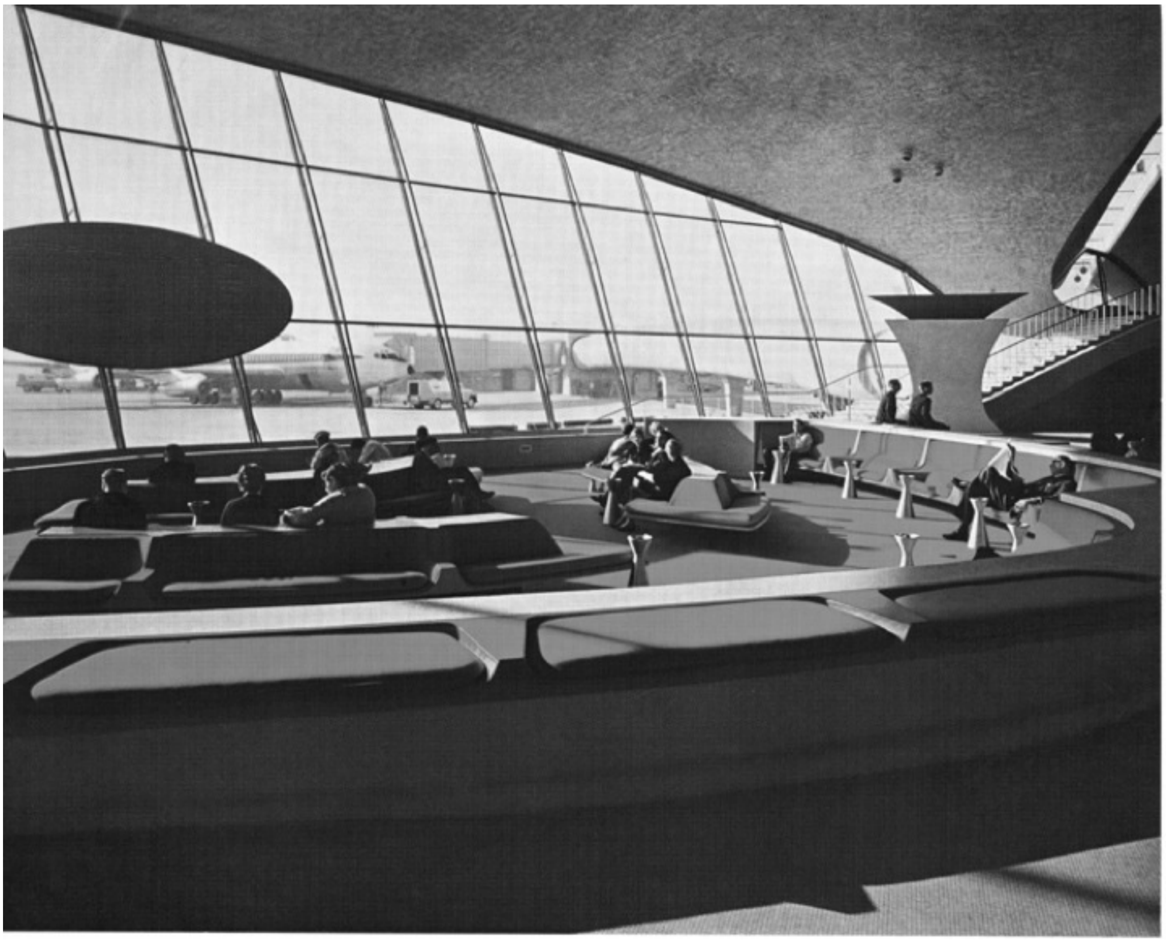
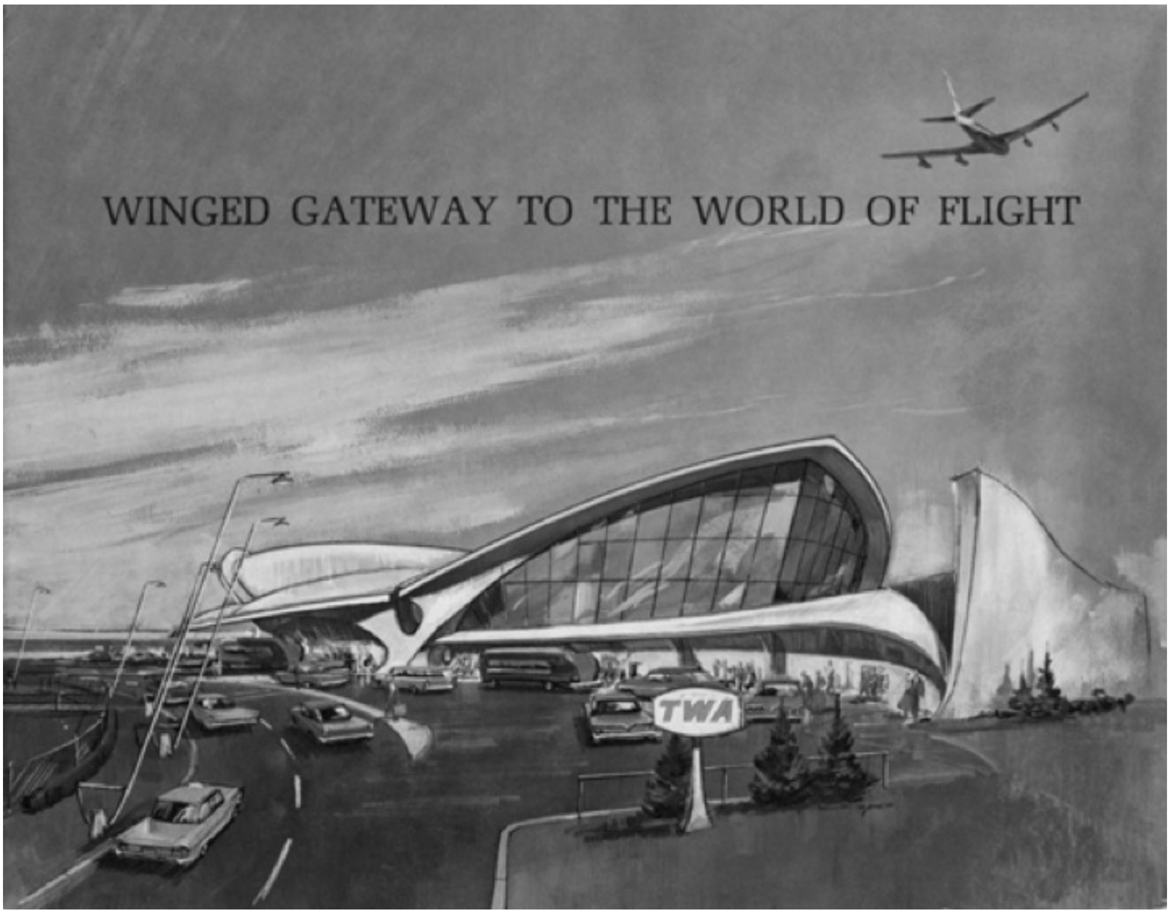
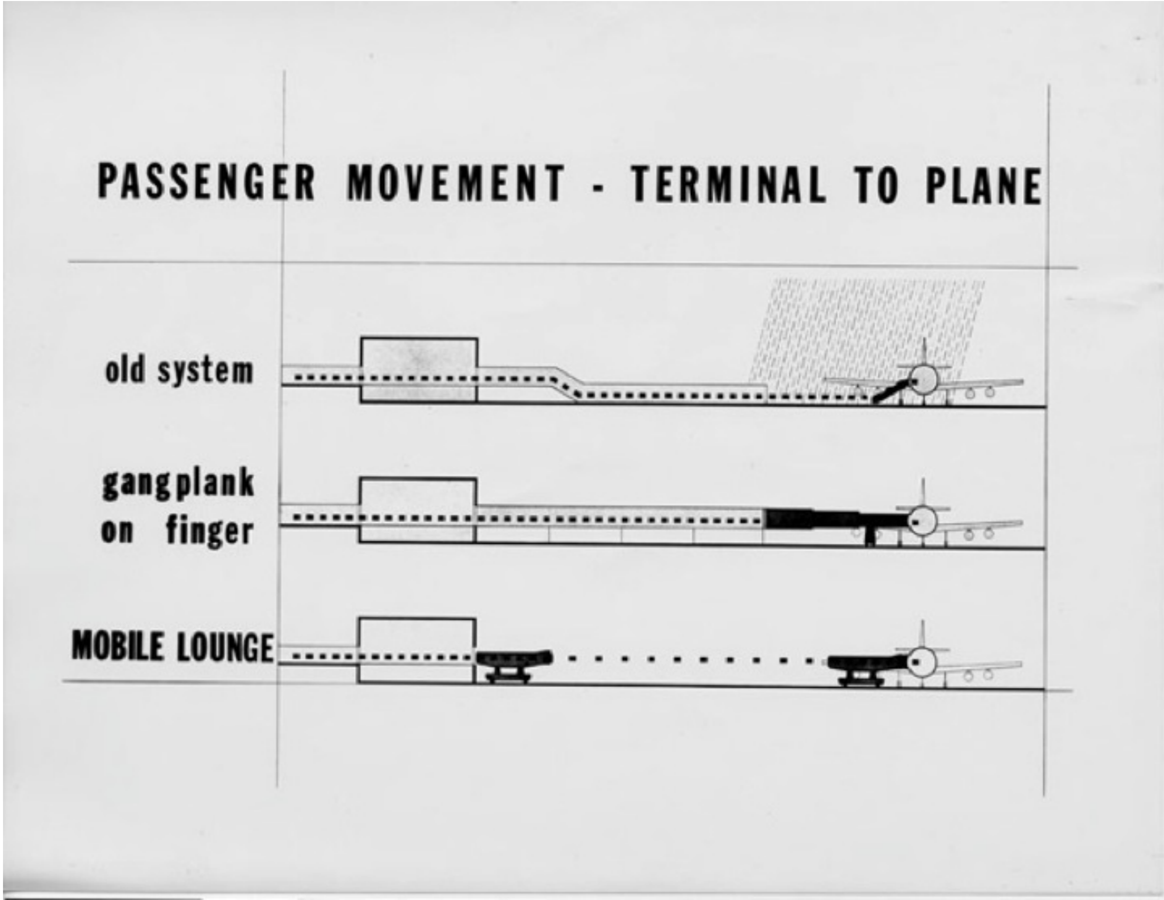
5.13. Trans World Airlines Terminal, New York, NY, press material showing an air view of the terminal and Flight Wing



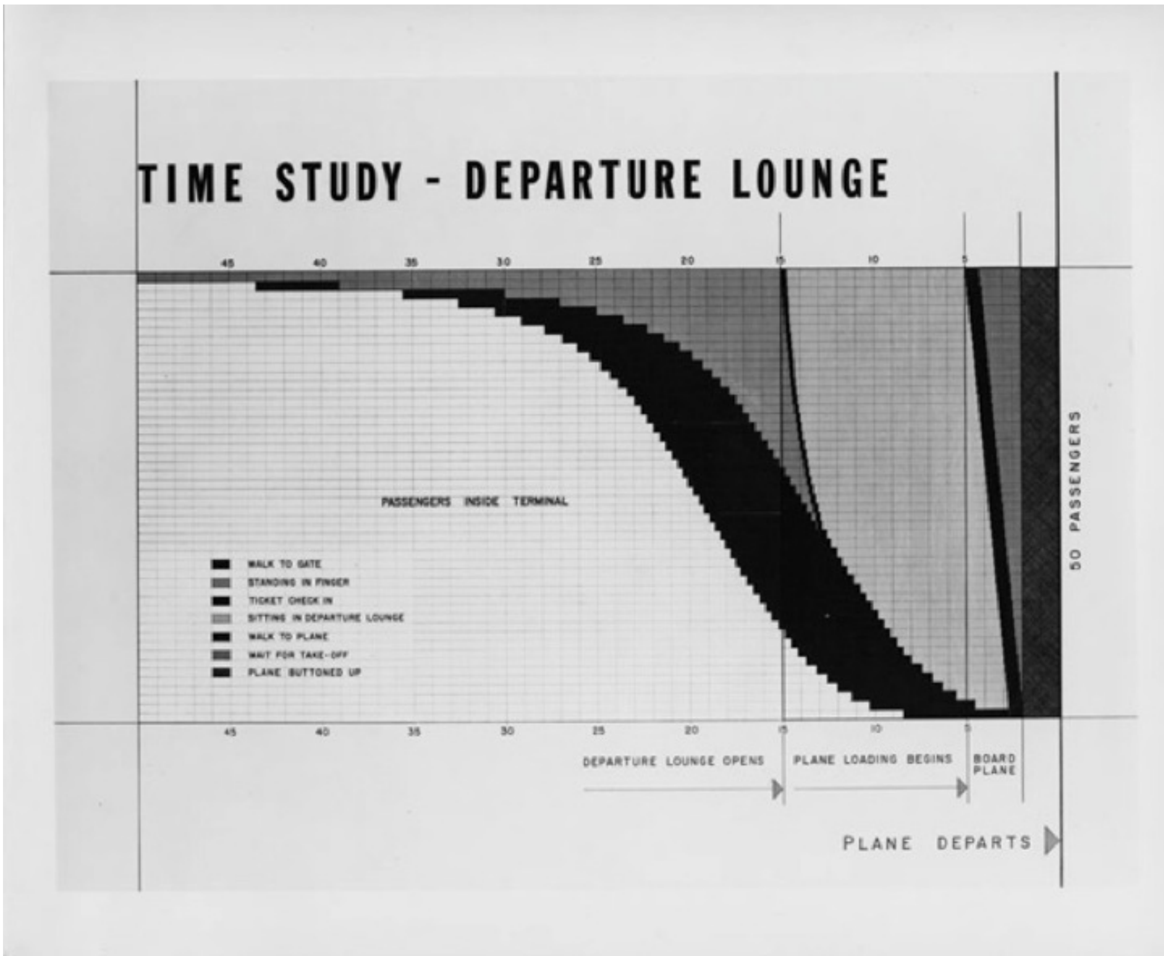
5.14. Trans World Airlines Terminal, New York, NY, conversation pit in waiting area



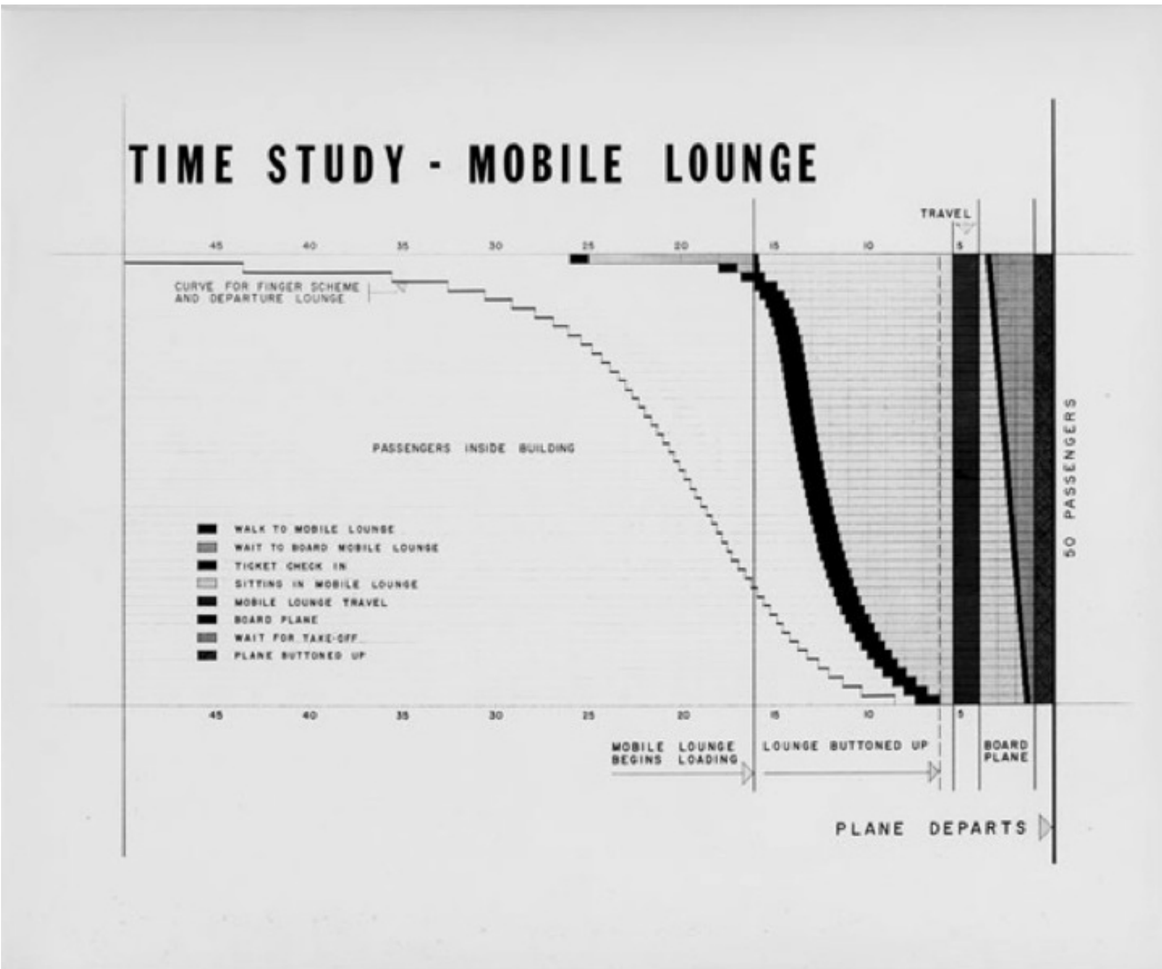
5.15. Trans World Airlines, New York, NY, TWA brochure



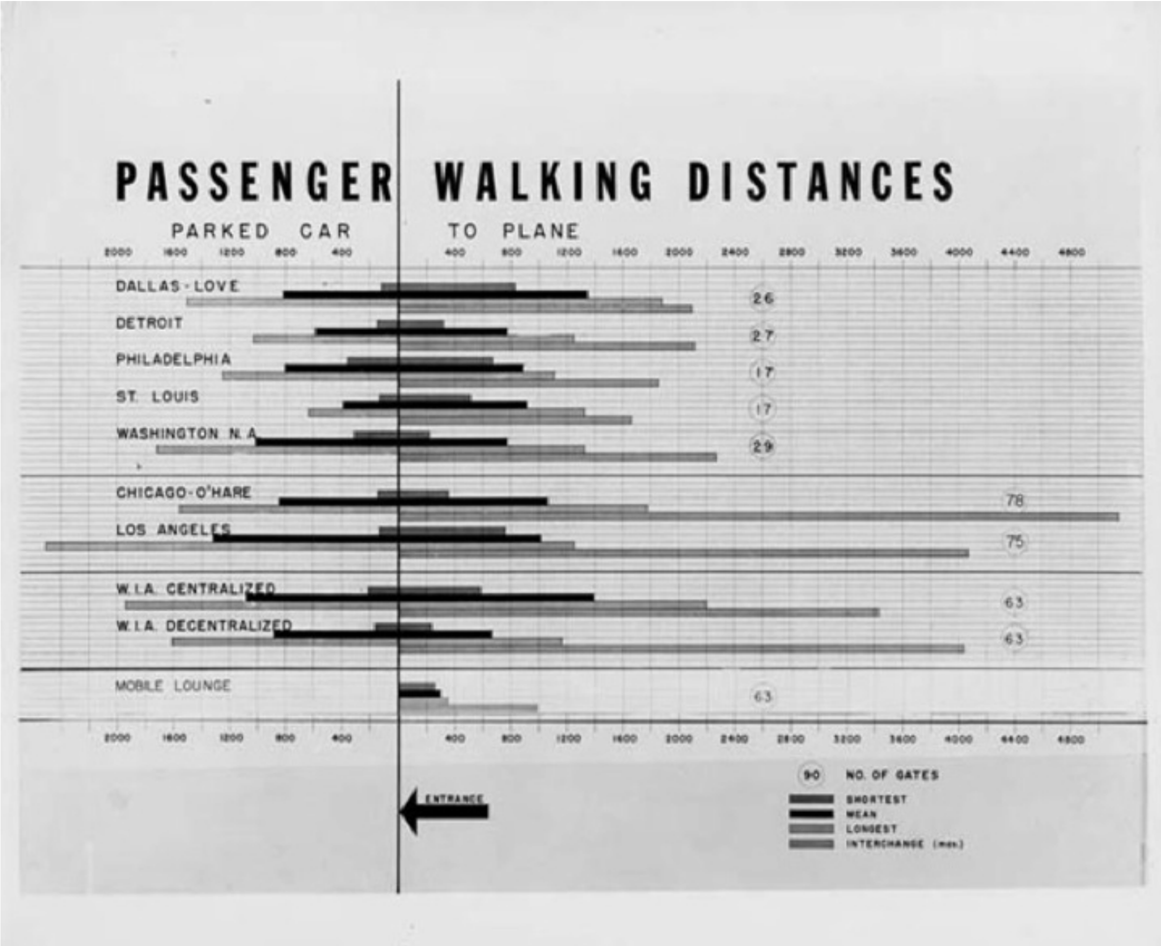
5.16. Dulles International Airport, Chantilly, VA, passenger movement terminal to plane diagram



5.17. Dulles International Airport, Chantilly, VA, departure lounge time study

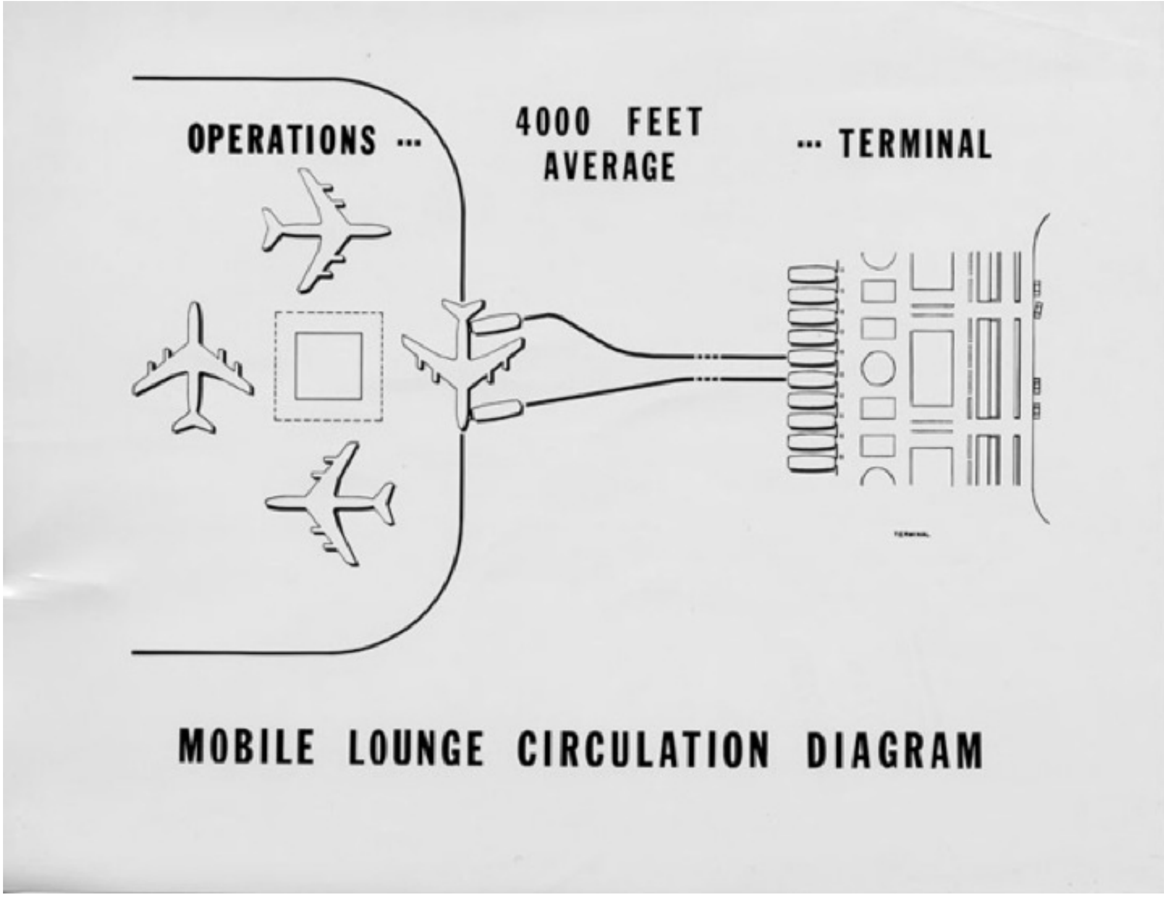


5.18. Dulles International Airport, Chantilly, VA, mobile lounge time study



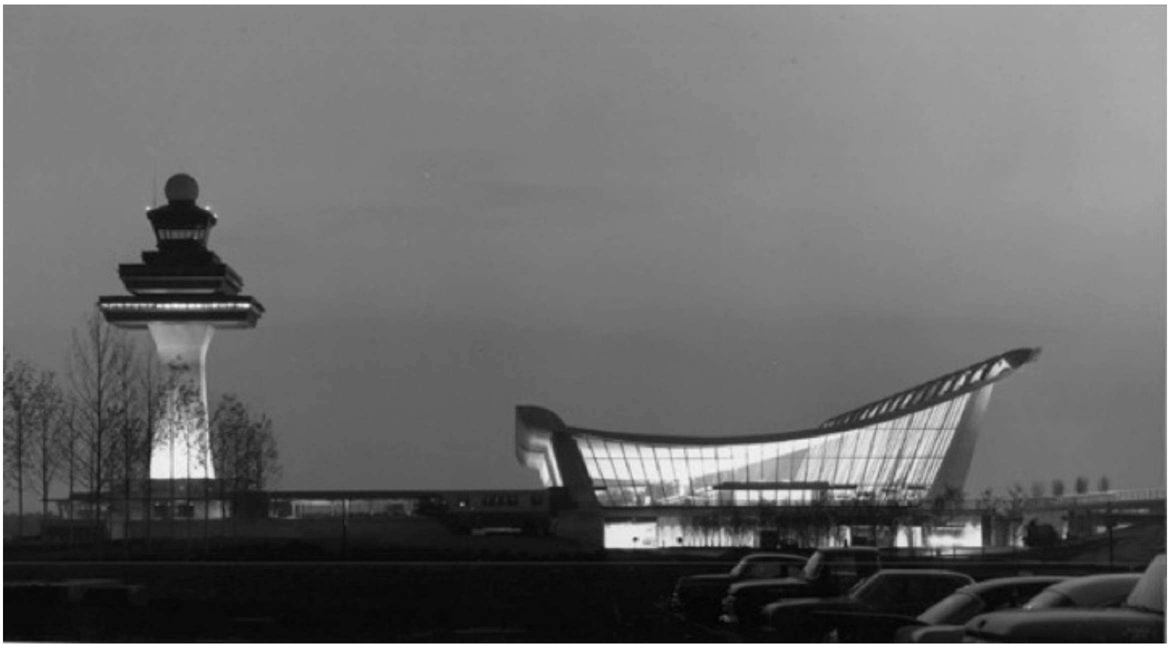
5.19. Dulles International Airport, Chantilly, VA, comparative passenger walking distances

5.20. Saarinen's ticket for the first jet flight

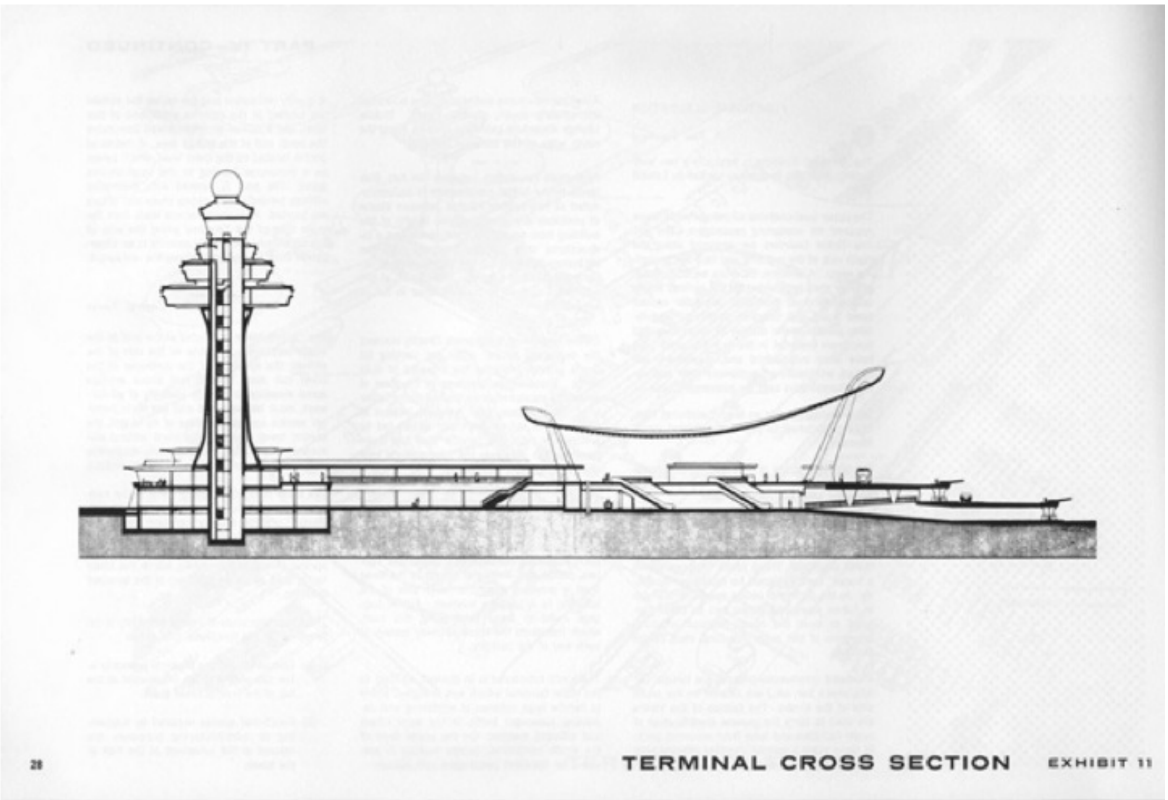


5.21. Dulles International Airport, Chantilly, VA, mobile lounge circulation diagram

5.22. Dulles International Airport, Chantilly, VA, mobile lounge mates with Electra II after the first flight into Dulles on September 9, 1961



5.23. Dulles International Airport, Chantilly, VA, photo: Balthazar Korab, courtesy of The Library of Congress

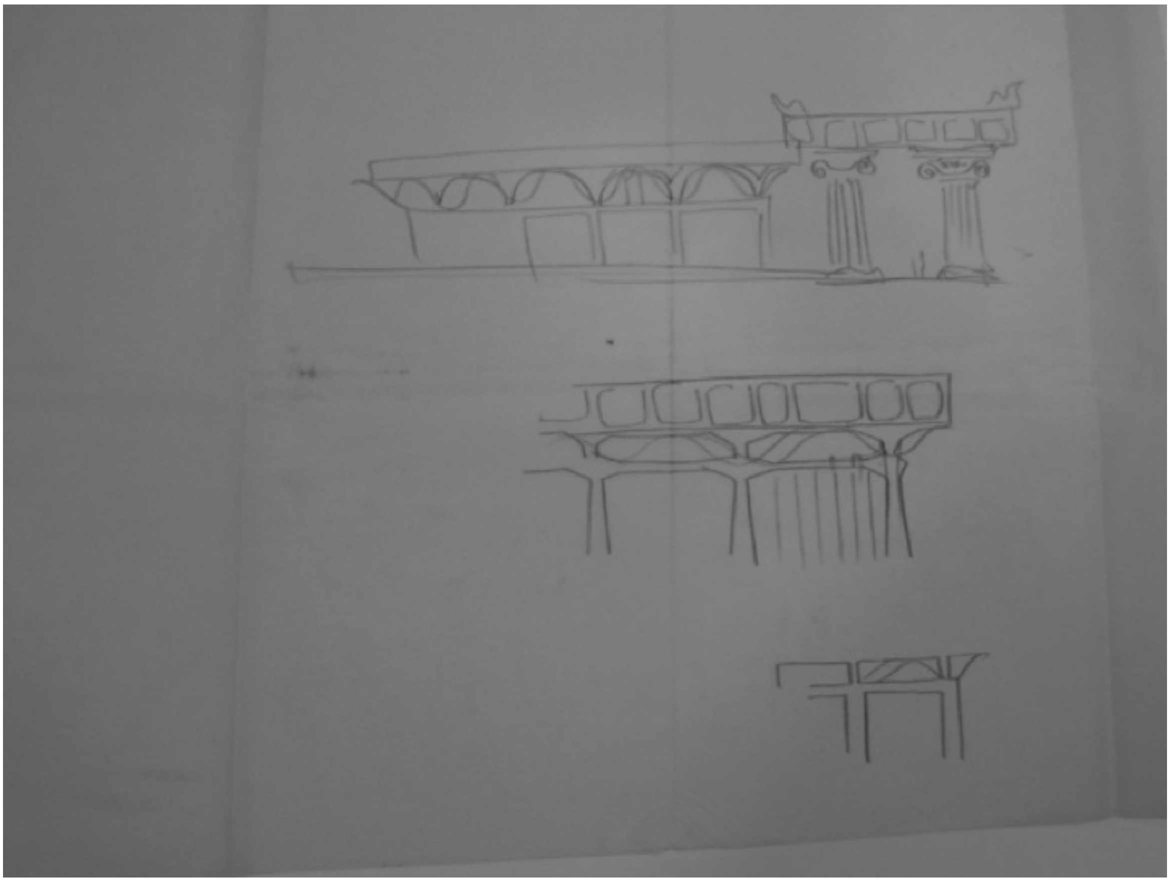


5.24. Dulles International Airport, Chantilly, VA, terminal cross section

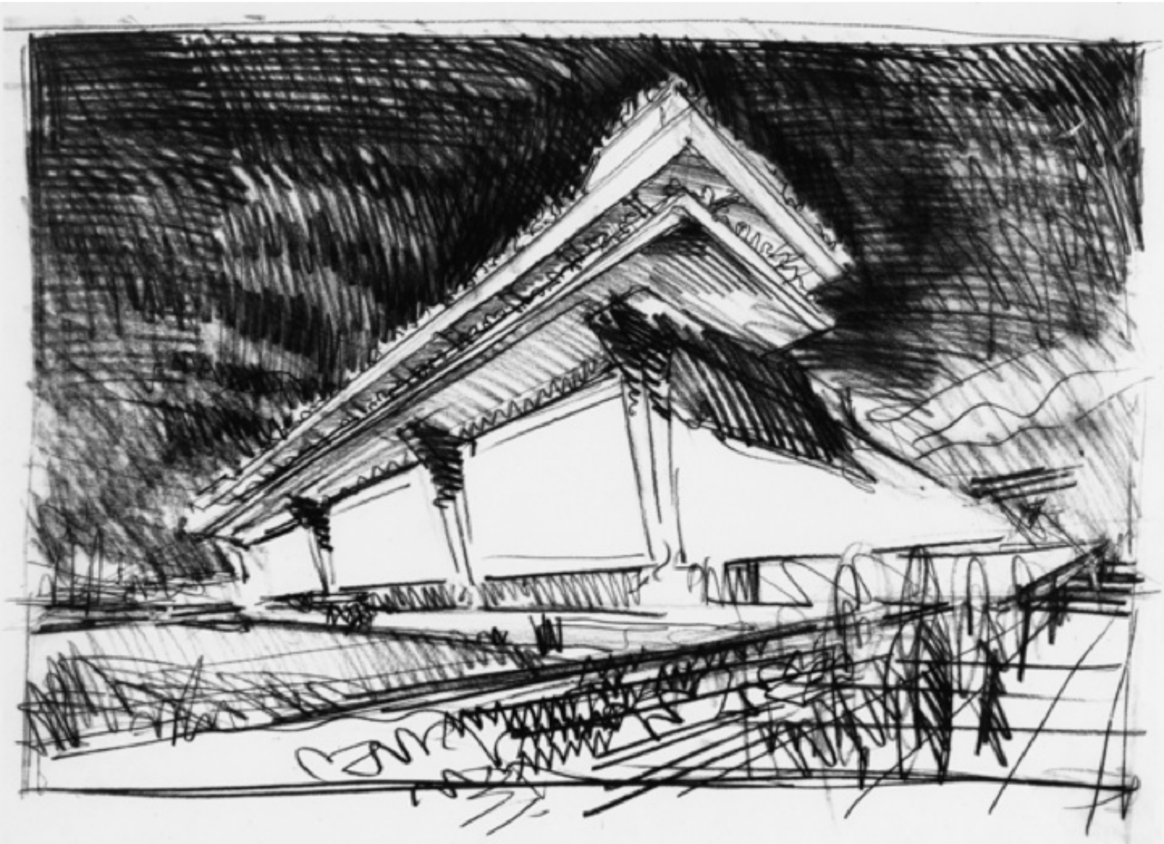
5.25. Dulles International Airport, Chantilly, VA, interior, photo: Balthazar Korab, courtesy of The Library of Congress

5.26. Dulles International Airport, Chantilly, VA, under construction

5.27. Dulles International Airport, Chantilly, VA, mobile lounge interior, photo: Balthazar Korab, courtesy of The Library of Congress



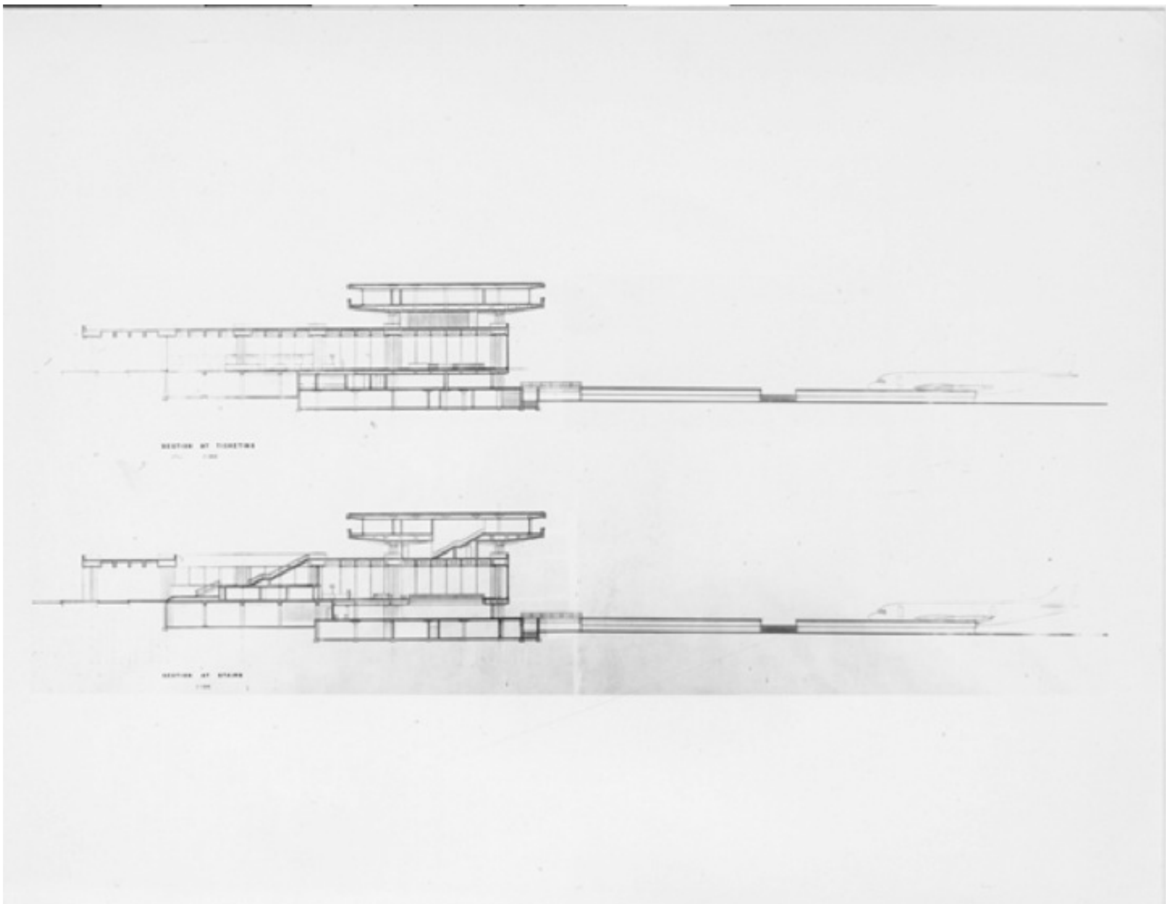
5.28. Athens International Airport, Athens, Greece, conceptual sketches, courtesy of Canadian Centre of Architecture, Montreal, Gift of David Graham Powrie



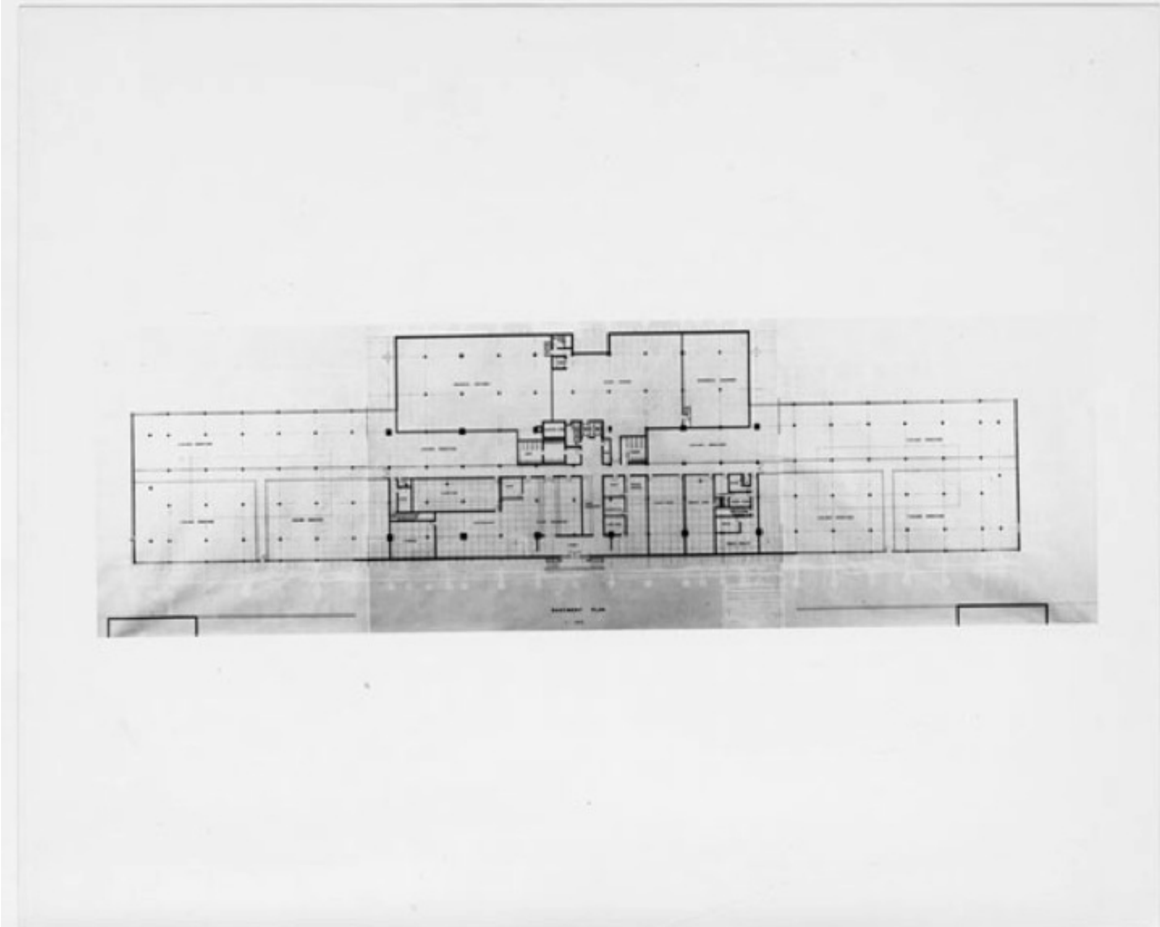
5.29. Athens International Airport, Athens, Greece, first proposal sketch

5.30. Athens International Airport, Athens, Greece, model viewed from the tarmac

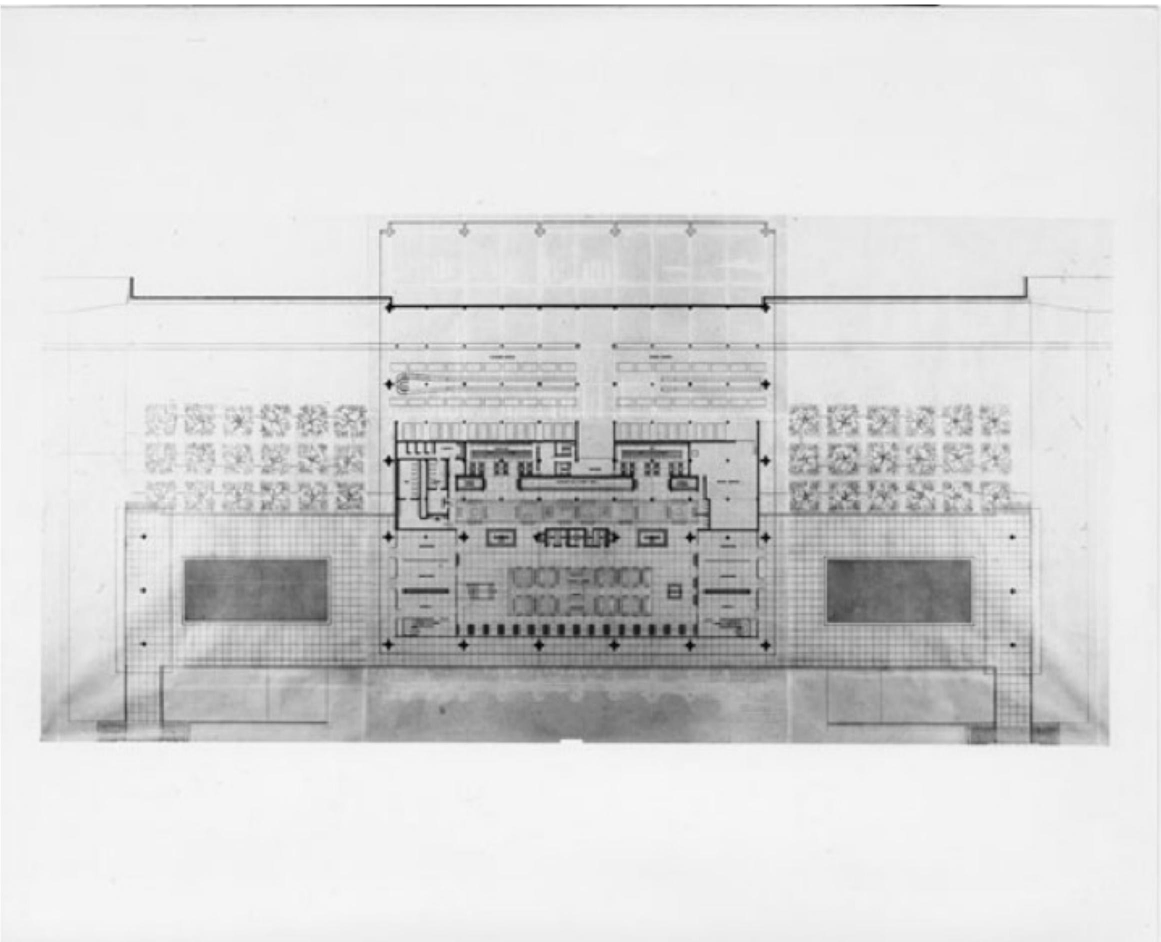
5.31. Athens International Airport, Athens, Greece, view of the terrace



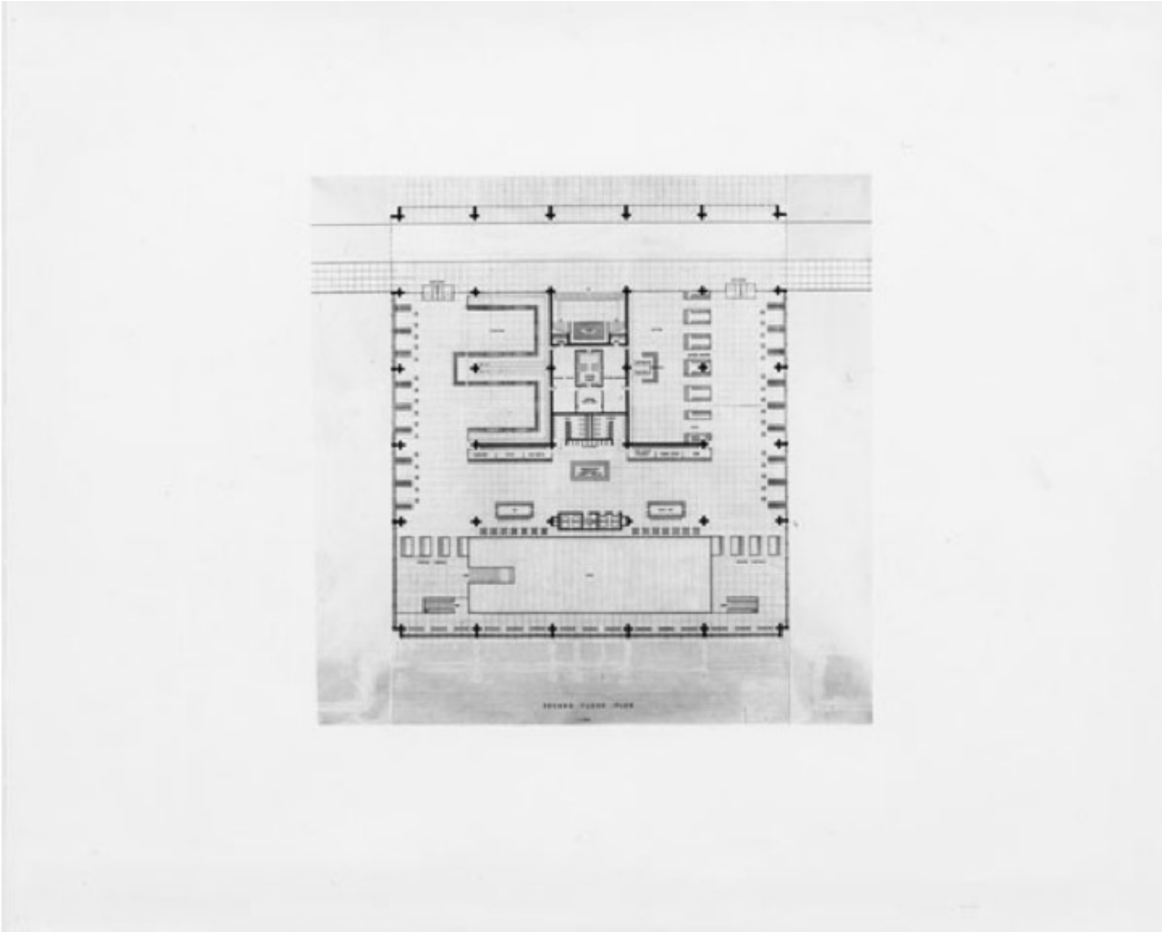
5.32. Athens International Airport, Athens, Greece, sections at ticketing and stairs



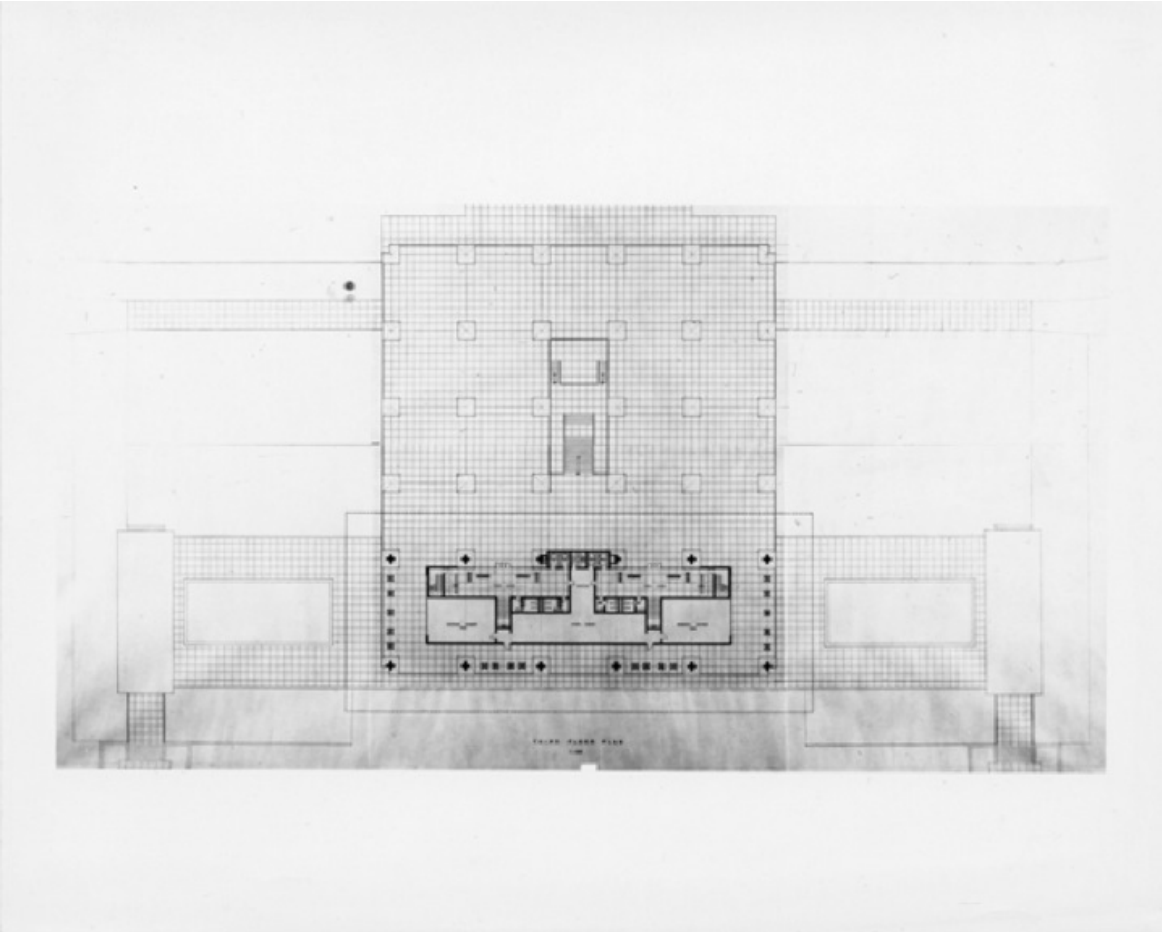
5.33. Athens International Airport, Athens, Greece, basement floor plan



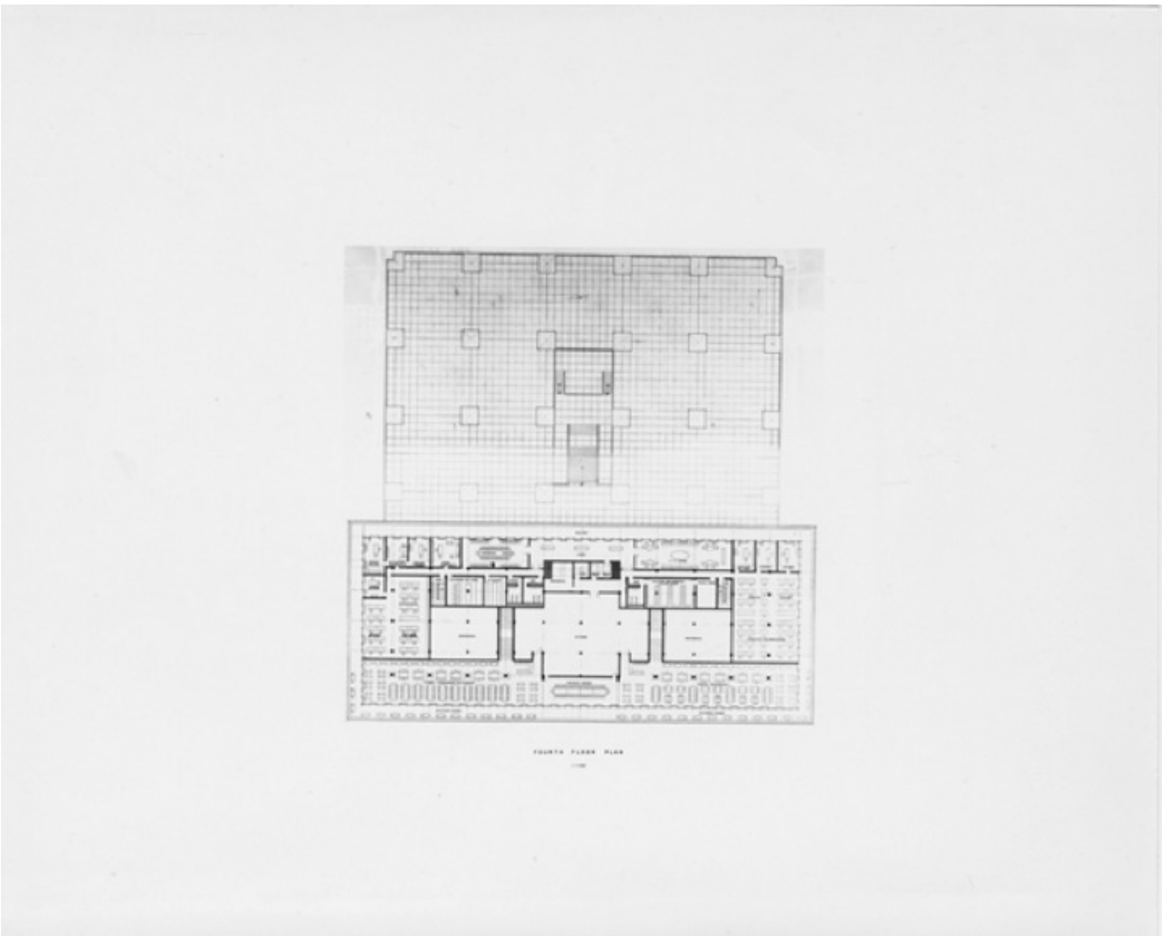
5.34. Athens International Airport, Athens, Greece, main floor plan



5.35. Athens International Airport, Athens, Greece, second floor plan



5.36. Athens International Airport, Athens, Greece, third floor plan



5.37. Athens International Airport, Athens, Greece, fourth floor plan